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A REVIEW

OF

MINING OPERATIONS

IN THE

STATE OF SOUTH AUSTRALIA

DURING THE

HALF-YEAR ENDED JUNE 30th, 1914.



No. 20.

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COMPILED, AND ISSUED UNDER THE AUTHORITY OF THE

HONORABLE SIR RICHARD BUTLER, M.P.,

Minister of Mines,

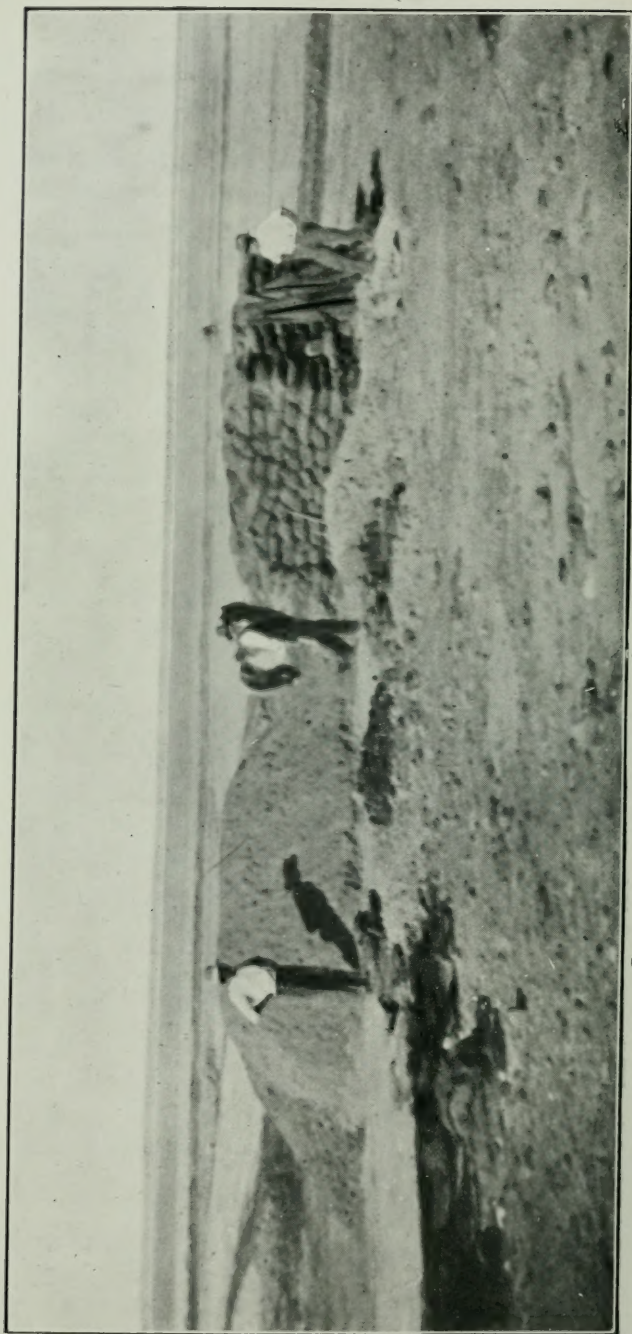
By **LIONEL C. E. GEE**, Acting Secretary for Mines.

DEPARTMENT OF GEOLOGICAL SCIENCE
UNIVERSITY OF TORONTO

Adelaide :

R. E. E. ROGERS, GOVERNMENT PRINTER, NORTH TERRACE.

1914.



Pernatty Lagoon.

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Miners' Rights and Privileges thereunder.

A miner's right is obtainable at the Department of Mines, Adelaide, also at the issuing stations in the various mining districts, at a cost of 5s.

A miner's right is in force for one year from the date of issue, and may be renewed at any time during its currency for another term of one year on payment of 5s.

The holder of a miner's right is authorised to prospect on any mineral lands for any metal, mineral, coal, or oil, and to peg out (of the prescribed shape and dimensions) gold, mineral, coal, and oil claims, and also leases of a like nature.

AREAS AND WORKING CONDITIONS.

GOLD LEASES—Maximum area, 20 acres; working conditions, one man to every five acres.

MINERAL LEASES—40 acres; one man to every 10 acres.

MISCELLANEOUS LEASES—

Salt	640 acres; special conditions.
Gypsum	640 " "
Mining Works.....	10 " one man.
COAL OR OIL LEASES	640 " one man to every 40 acres.
GOLD DREDGING LEASES	200 " special conditions.
MINERAL CLAIMS	40 "
GOLD CLAIMS.....	30ft. x 30ft., alluvial; 100ft. x 600ft., reef.

Gold claims must be constantly worked—one man for each claim—and mineral claimholders must employ two men for each claim. Amalgamation of either gold or mineral claims reduces the labor conditions by one-half.

Gold, mineral, coal, and oil leases are granted for a term of 42 years—the two former at a rental of 1s. per acre per annum and a royalty of 6d. in the pound on net profits, the latter at a rental of 6d. per acre per annum until coal or oil is found in payable quantities, when 1s. per acre is payable and a royalty of 6d. in the pound on the net profits.

The Minister may permit, for the concentration of labor, of the amalgamation of not more than four adjoining gold or mineral leases.

Any number of gold, mineral, coal, or oil leases may be held by one person.

Licences to search for twelve months for precious stones, mineral phosphates, oil, rare metals, minerals, and earths are issued on specific mineral lands, not exceeding five square miles in area for one person, a fee of 20s. being charged for each square mile or portion thereof. These licences give a preferential right to a lease over a portion of the area, as prescribed.

PREFACE.

THE copper market during the six months has been good, although the average price is £5 os. 4d. per ton less than that of the previous half-year.

The dry season has militated against prospecting and the working of outside shows.

A considerable amount of interest has been called to the copper deposits at Pernatty Lagoon, and the interesting reports of Mr. W. E. Wainwright and Mr. F. M. Murdock are included in this Review.

The services of Dr. Arthur Wade, the well-known petroleum specialist, have been secured to examine and report on the possibilities of making discoveries in this State.

LIONEL C. E. GEE.

August, 25th, 1914.

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Mining Operations during the Half-year ended June 30th, 1914.

AREA AT PRESENT HELD UNDER MINING ACTS

(JUNE 30TH, 1914).

Nature of Holding.	Number.	Area.
Mineral leases	306	14,073 acres
Gold leases	60	1,134 "
Gold dredging leases	1	200 "
Miscellaneous leases	65	16,527 "
Coal and oil leases	1	640 "
Mineral claims	471	18,928 "
Occupation licences	195	97½ "
Search licences	220	551,680 "
Coal and oil claims	39	24,760 "
Gold claims	3	8 "
Total holdings	1,361	628,047½ acres

REGISTERED FROM JANUARY 1ST, 1914, TO JUNE 30TH, 1914.

Mineral leases	42	1,600 acres
Gold leases	4	80 "
Gold dredging leases	—	— "
Miscellaneous leases	6	689 "
Coal and oil leases	—	— "
Mineral claims	119	5,370 "
Coal and oil claims	12	7,480 "
Gold claims	—	— "
Occupation licences	31	15½ "
Search licences	95	224,640 "
Miners' rights	675	—
Total	984	239,874½ acres

MEN EMPLOYED.

Estimated number of men employed in mining and mineral works, December 31st, 1913 :—

Copper	4,000
Gold	500
Salt	500
Silver-lead	30
Other minerals	450
Smelting works, Port Pirie	1,500
Raising flux in connection therewith	150

Total..... 7,130

GENERAL NOTES.

The average price of standard copper for the half-year is £63 19s. 4d., the range of prices being—highest, February 4th, £66 17s. 6d ; lowest, June 27th, £60 2s. 6d. The average for the six months ended December 31st, 1913, is £69 0s. 2d.

At the *Walleroo and Moonta Mines* matters have proceeded in the usual satisfactory way. From the *Walleroo* 64,174 tons of 3·36 per cent. ore, and from the *Moonta* 16,078 tons of 3·10 per cent. have been treated ; and also the usual work at the flotation plants has been carried on.

The *Hamley Mine* has been worked by 14 tributers, and 10½ tons of copper produced. *Vide* Inspector's report, page 55, also report on the *West Burra*, page 54, and the *Utica*, page 55.

At *Mount Lyell Consols Wallaroo Copper Mine* operations have been suspended pending the installation of a complete and up-to-date pumping plant, to enable sinking to be continued.

Tumby Bay Copper Mine.—Stephens' shaft has been sunk to water-level, and Prisk's shaft 82ft. to a total depth of 165ft. Cut plat at 100ft. and completed connection with Stephens' shaft. A few tons of ore have been raised. The work is assisted by a Government subsidy.

Montacute.—The *Montacute Company* was wound up, and its interests in the property sold to the *Sixth Creek Copper and Gold Mining Company*, and, with the assistance of a Government subsidy, work has been resumed.

Very little is being done at the *Mutooroo Copper Mine*. Bailing operations are being carried out weekly ; the mine water being allowed to rise to the friable zone with a view of strengthening its copper contents. When the water is sufficiently strong leaching operations will be resumed.

At the *Trinity Copper Mine*, near Mutooroo, two shallow shafts have been sunk and a little costeening done.

New Year's Gift Mine, near Ethiudna Hill, North-East, was originally known as the *Ethiudna Mine*, and was worked for copper, cobalt, and nickel. Operations have now been restarted, and a detail official report will be found on page 59.

At the *Blinman* about 25 tons of ore have been raised and marketed.

At *Paull's*, near Leigh Creek, only a little copper ore has been raised. The work done consisted of trenching on the surface, driving W. at the 60ft. level, sinking winze and driving from it.

At the *Dorris Fabian*, adjoining *Paull's*, the shaft has been timbered and sunk 40ft., making total depth 80ft. A Government subsidy has been granted.

The old *Nuccaleena Mine* is being reworked by Hunter Brothers, with the assistance of a subsidy from the Government.

Operations on a small scale have been in progress on the *Warra Warra*, *Windy Creek* (near Parabarana), *Beltana Rapid Ore Treatment Syndicate*, *Copper Queen* (near Beltana), *Boulder* (near Wooltana), *Nichol's Nob*, and other copper mines in the North.

A subsidy has been granted to help in the restarting of the old *Kanappa Copper Mine*, in the hundred of Angas.

St Elmo, formerly known as the *Carn Brea Copper Mine*, near Robertstown.—A syndicate has been working this property, and has sunk the vertical shaft from 40ft. to 100ft., and made a crosscut W. from the bottom for 58ft. A vertical shaft has been sunk 20ft. and a tunnel driven into the hill 130ft.

North-west of Port Augusta a little work has been done at the *Sweet Nell* and *Monalena* claims, near Ironstone Lagoon.

Mount Gunson.—The work here has consisted of prospecting, boring, and sinking, specially for obtaining an adequate water supply, preliminary to erecting the necessary treatment plant.

Considerable attention has been paid to the copper ore deposits at *Pernatty Lagoon*, and, by the courtesy of the directors of the Pernatty Syndicate, the report of Mr. W. E. Wainwright on the deposits, and that of Mr. F. M. Murdock on the suggested mode of treatment, are published in this Review. *Vide* pages 41, 54.

Gold returns from the Government Battery and Cyanide Works, Tarcoola, show 316 tons treated for 631ozs. 19dwts. 14grs. of bullion, valued at £2,224 18s. 8d., or 140½s. per ton. The best return was from the *Day Dawn*, viz., 102½ tons for 447ozs. 10dwts. 22grs., worth £1,208 19s. 11d.

At the Petersburg Battery 52 tons 3cwts. of stone from the *Golden Junction*, near Mount Grainger, produced 64ozs. 18dwts. 6grs., valued at £249 1s. 6d.

Only a little work has been done at the *Medora and Mount Grainger*, and no stone treated. Returns show that from these mines altogether 3,127 tons 4cwts. 1qr. have been treated for 1,365ozs. 8dwts. 3grs. of gold bullion, worth £5,143 7s., an average value of £1 12s. per ton of ore.

Work has been discontinued at the *Ajax Mine* near Waukaringa.

A dam has been excavated by the Government at *Kirkeek's Treasure*, the holding capacity is 911,250 gallons, and it is hoped that when rain comes this promising mine will be in full work again.

A little reef prospecting has been done at *Teetulpa*.

The improved prospects of the *Wadnaminga* district have attracted a few more prospectors to the field, who are working some promising-looking shows.

The owner of the *Milo* forwarded two parcels to Petersburg, of which the first—30½ tons—returned 76s. per ton, and the second—16 tons—gave 144s. per ton. A good face of stone is now showing.

A syndicate has been formed to re-treat the *Milo* sand dump, and a plant, consisting of three 15-ton vats, was installed with necessary appliance. The returns from the first 87 tons treated (about 9ozs.) was considered satisfactory, and the directors decided to instal three 30-ton vats.

Mr. Allanson, at the *Virginia*, is still treating the old sand dump with good results, and stopes, &c., are being prepared to keep the battery going in the near future.



Cooladdin Rocks, near Tarcoola.

Reports by Inspector Jones on this field will be found at pages 57.

Kitticoola, Reedy Creek.—No ore has been treated since January 17th, and since that time the mine has been unwatered and drives made at the 330ft. level, N. and S., 50ft. each way.

Deloraine Gold Mine.—The results of the work at this mine for the past half-year have been encouraging. The main shaft has been deepened 36ft. in good ore, and sinking is to be continued to the 300ft. level. The reef at the 192ft. level has been proved to extend for a distance of 196ft., as against 90ft. in the 100ft. level. The average width for the first 155ft. was 3ft. 6in., worth 68s. per ton. At this point it became a little poorer and more broken up. In the last 10ft. it improved again in size and value, the width in the face being 3ft., worth 53s. per ton. For the half-year ended April 30th a profit of £662 was made over and above all expenses, and an extension of the crushing plant is contemplated, a call of 1s. per share having been made to provide the funds. For the six months ended June 30th, 1914, 1,055 tons of ore were treated, containing 876·25ozs. gold and 1·57 tons copper, of a total value of £3,334 18s. The following statement shows the total production of the mine to April 30th, 1914 :—

	Tons.	Value of Gold Recovered.			Value of Copper Recovered.			Total Gross Value Recovered.		
		£	s.	d.	£	s.	d.	£	s.	d.
Ore treated up to Oct. 31, 1913	2,967	8,611	5	6	300	9	9	8,911	15	3
Ore treated for half-year ended April 30, 1914	1,027	3,186	3	3	141	9	3	3,327	12	6
	3,994	£11,797	8	9	£441	19	0	£12,239	7	9
Add estimated value of concentrates in transit . .								257	0	0
								£12,496	7	9

Cowell Silver-Lead.—With the aid of a Government subsidy, work is in progress on this property, but so far nothing special has been struck. *Vide* Inspector Jones, report, page 62.

The work done at the *Mount Malvern Silver-Lead Mine*, near Cherry Gardens S. of Adelaide, consists of driving at 214ft. level W., sinking a winze, unwatering the mine to 306ft. level, driving W. towards winze with view of connecting with upper levels.

The old silver-lead mine at *Duck Pond Hill*, near Mount Freeling, has been again taken up, and about 25 tons of ore raised.

Radium Hill.—About 130 tons of ore have been raised, and alterations made in the plant while waiting for a new engine, which has now been installed.

Mr. B. Du Faur is now manager at the mine.

Mr. Joseph Thompson, of Sydney, a director, supplies the following notes:—

“ Since the end of the company's financial year, on June 30th, 1913, the works at Woolwich have produced from the ore won at the *Radium Hill Mine* at Olary upwards of 239 milligrams of radium preparation of high grade. Three small parcels were, on different occasions, sent away for certification, the results appear in the tabulated statement at foot, which the board consider very satisfactory.”

Date of dispatch.	Estimated Quantity.	Mr. Radcliff's Estimate of Hydrated Radium-Bromide contents.	Tested at	Certified contents.	
				Radium.	Hydrated Radium-Bromide.
December, 1913	Milligrams. 35	Milligrams. 33·34	Charlottenburg	Milligramme. 21·36	Milligrams. 33·98
April, 1914, in fulfilment of order for 50 milligrams at 50 % concentration....	50	25	National Physical Laboratory	13·2	24·62
May, 1914.....	11·5	10·5	National Physical Laboratory	5·8	10·8

Radium Extraction Company of South Australia, Limited, Mount Painter, Flinders Range.—The secretary (Mr. J. K. Samuel) supplies the following notes:—

In the last Review, to December 31st, 1913, it was reported that 20 tons of ore had been shipped to London for disposal. This ore consisted of three different lots, and assays made in London by Mr. Benedict Kitto gave the following results:—

Lot 2	52 bags	..	5·01	per cent.
Lot 3	346 bags	..	3·03	“
Lot 4	174 bags	..	3·14	“

Endeavors are now being made by the company's agents to realise this ore to the best advantage.

An open cut was started at No. 6 workings, and some rich ore was won from the veins occurring in the crush zone. Altogether 60 tons were extracted, averaging about 1 per cent. From No. 7 workings 3 tons, worth ·8 per cent. U_3O_8 was obtained, and 16cwts. specimen ore, worth from 5 per cent. to 20 per cent., was gathered from both these points. The manager, Mr. H. G. Stokes, F.G.S., has evolved a leaching process by which it may be possible to treat low-grade ore profitably at the mine. His process carries the extraction to the recovery of a crude radium barium sulphate, and inquiries are being made to ascertain whether the radium is marketable in this form.

Vide also further report by the Government Geologist on this property, page 36.

Attention is also called to the following reports by the Government Geologist :—

Flag Stone Quarries, near Mintaro, page 35.

Magnesite, near Tumby Bay, page 30.

Talc, near Yaranyacka, page 40.

Core from Paradise Cove Bore, Highbury, page 42.

Deposit of Shale and Brown Coal at Bower.

During the past 12 months active operations have been commenced at Bower, on the Morgan railway line, 87 miles from Adelaide, to sink down to a seam of shale and brown coal passed through in 1902 by a diamond drill operated by the Engineer-in-Chief's Department, boring for a supply of water for railway and domestic purposes. A diagram of the core of the drill preserved by the department shows that for 112ft. from the surface clay of various grades was met with ; then from that distance to 330ft. soft calcareous rock and clay with marine fossils comprised the country passed through. At that point black shale was entered, which continued for a depth of 71ft., when the brown coal was encountered, and this was found to be 42ft. thick. The underlying country was white pipeclay, followed by highly-decomposed micaceous rock, which was bored into until a depth of 496ft. had been reached, when the bore was lifted.

A shaft (10ft. by 4ft. in the clear) has been started immediately over the bore-hole, and has reached a depth of 82ft. Arrangements have now been completed for erecting poppet legs and up-to-date winding plant.

The shaft is within 400yds. of the Bower Railway Station, and the Morgan line passes within a few hundred feet.

As will be seen by the returns on page 5 a large number of search licences for oil have been taken out. Boring operations have been started at Wanilla, near Port Lincoln, by the Eyre Peninsula Petroleum Oil Company, and at near Kingston, in the South-East, by Mr. Whaley on behalf of a syndicate.

It is reported that prospecting operations recently carried out on the *alumite deposit* at Carrickalunga Head have been successful.

A trial shipment of 10 tons of the alumite has been dispatched to England, and news with regard to its market value is expected shortly.

An open cut has been made at the site of the principal occurrence, and a shaft has been sunk on the deposit to a depth of 30ft., with satisfactory results. There are 20 tons of alumite now bagged at the surface.

DEPARTMENT OF MINES.

“THE NATIVE INDUSTRIES ENCOURAGEMENT ACT, 1872.”

Notice of the Offer of a Bonus for the Discovery of Oil.

Adelaide, January 19th, 1914.

A bonus of £5,000 is offered to the person or body corporate which first obtains from a bore or well situated in the State of South Australia 100,000galls. of crude petroleum, containing not less than 90 per cent. of products obtainable by distillation.

No application for a bonus will be considered unless the following conditions have been strictly complied with :—

1. The applicant for the bonus must have furnished to the Minister of Mines, during the progress of drilling operations—

- (a) A monthly record of work done ;
- (b) A full log of all bores and wells sunk, whether successful or unsuccessful,
- (c) Samples of materials passed through by the bores, to be taken at every 50ft. sunk, and also at every change of country encountered ;
- (d) A declaration pursuant to “ The Statutory Declarations Act, 1835,” of the exact locality of each bore or well. (This should be furnished with the first monthly report on the bore or well).

2. The oil must have been stored at the bore or well from which it has been obtained until the whole 100,000galls. has accumulated.

3. The applicant must furnish with his application—

- (a) The certificate of a licensed surveyor nominated by the Minister of Mines as to the quantity of oil so stored ;
- (b) The certificate of the Government Analyst of the result of his analysis of samples of the oil taken by a person nominated by the Minister of Mines ;
- (c) A declaration pursuant to “ The Statutory Declarations Act, 1835,” that the whole of the oil for which the bonus is claimed was obtained from the bore or well where it is stored.

4. Within 24 hours of the first discovery of oil in the well or bore, notice of such discovery must be sent to the Minister of Mines.

5. Any person who desires at any time to inspect or test the well or bore on behalf of the Minister of Mines must be granted every facility for this purpose.

6. The applicant must have done nothing contrary to the provisions of “ The Mining Act, 1893,” or “ The Mining Act Amendment Act, 1900,” or of any lease or licence granted to the applicant under either of these Acts.

R. BUTLER, Minister of Mines.

CRUSHING AND CYANIDING PLANTS.

A summary of the work done on the State Batteries and Cyanide Works for the year ended June 30th, 1914 shows that 23 parcels of ore have been received for treatment from various parts of the State. These parcels comprise 1,562 tons 17cwts. 0qrs., and yielded 2,289ozs. 10dwts. 19qrs. of gold bullion, valued at £8,016 19s. 7d.; the average yield per ton being worth 102 shillings, which can only be regarded as very encouraging. The surplus on the parcels treated amounts to £7,148, which means that the Department of Mines have, through the gold won at the State Batteries, been able to return to the prospector as a net profit on the treatment of their ores, £595 per month during the 12 months.

In addition to the foregoing, 1,065 tons of tailings have passed through the cyanide vats, and 409 assays and tests of small parcels of ore and tailings have been made on the various works.

The total value of the gold bullion produced on the State Batteries and Cyanide Works since their inception is £73,192.

E. L. GRUNDY,

General Manager State Batteries and Cyanide Works.

RETURNS FROM GOVERNMENT CRUSHING AND CYANIDING PLANTS FOR THE HALF-YEAR ENDED JUNE 30TH, 1914.

Name of Mine.	Locality.	Weight of Ore.	Gold Bullion Recovered.	Total Value of Bullion.	Yield per Ton, in Shillings
		Tons cwts. qrs.	Ozs. dwts. grs.	£ s. d.	s.
TARCOOLA BATTERY AND CYANIDE WORKS.					
Royal George	Tarcoola	6 0 0	3 2 22	10 4 7	34
Tarcoola Perseverance	"	50 0 0	65 2 12	243 11 4	97
Tarcoola Enterprise.. ..	"	25 0 0	68 17 22	227 15 2	182
Day Dawn	"	50 0 0	227 15 15	804 15 10	322
Morning Star	"	25 0 0	10 7 11	32 3 1	25 $\frac{3}{4}$
Royal George	"	30 10 0	36 11 10	134 9 0	88
Tarcoola Perseverance	"	50 0 0	82 17 17	311 10 11	124 $\frac{1}{2}$
Day Dawn	"	52 10 0	119 15 7	404 4 1	154
Tarcoola Enterprise.. ..	"	27 0 0	17 8 18	56 4 8	41 $\frac{1}{2}$
Total		316 0 0	631 19 14	2,224 18 8	140 $\frac{3}{4}$
Grand total since starting of battery ..		4,945 5 0	7,708 5 22	27,112 13 8	109 $\frac{3}{4}$

GLENLOTH BATTERY AND CYANIDE WORKS.

Glen Markie	Glenloth	32 0 0	11 7 18	42 3 8	26
Lone Hand	"	25 0 0	13 12 7	43 5 8	34 $\frac{1}{2}$
Lone Hand	"	34 0 0	22 4 4	83 3 9	49
Option Co. and others. .	"	105 0 0	34 2 0	96 6 7	18
Total		196 0 0	81 6 5	264 19 8	27
Grand total since starting of battery ..		2,515 10 0	2,168 11 23	7,258 9 7	57 $\frac{3}{4}$

RETURNS FROM GOVERNMENT CRUSHING AND CYANIDING PLANTS—*continued*

Name of Mine.	Locality.	Weight of Ore.	Gold Bullion Recovered.	Total Value of Bullion.	Yield per Ton, in Shillings.
		Tons cwt. qrs.	Ozs. dwts. grs.	£ s. d.	s.
PETERSBURG BATTERY AND CYANIDE WORKS.					
Wanda	Mannahill	5 2 0	8 8 7	33 4 11	130
Golden Junction	Mount Grainger ..	4 3 0	17 19 20	71 10 4	344½
New Milo	Wadnaminga	30 10 0	34 2 0	116 5 1	76
Golden Junction	Mount Grainger ..	48 0 0	46 18 10	177 11 2	74
Mines	Petersburg	*127 0 0	5 11 3	22 4 6	3½
Wandu (Homeward Bound)	Mannahill	4 18 0	8 4 4	32 13 6	133
New Milo	Wadnaminga	15 18 0	33 1 5	114 8 9	144
Total		235 11 0	154 5 11	567 18 3	83¾
Grand total since starting of battery ..		4,892 0 0	4,399 14 15	16,391 19 11	67

MOUNT TORRENS BATTERY AND CYANIDE WORKS.

Mount Torrens	Mount Torrens	50 0 0	6 15 0	20 5 0	8
Mount Torrens	"	6 0 0	1 2 0	3 6 3	11
Crane's	Blumberg	25 0 0	10 13 16	39 4 8	31
Total		81 0 0	18 10 16	62 15 11	15½
Grand total since starting of battery ..		10,433 11 3	5,925 14 15	22,429 1 1	42

RETURNS FROM CRUSHING AND CYANIDING PLANTS (OTHER THAN GOVERNMENT) FOR THE HALF-YEAR ENDED JUNE 30TH, 1914.

Name.	Ore Treated.	Gold Bullion Recovered.	Value.	Yield per Ton, in Shillings.
	Tons cwt. qrs.	Ozs. dwts. grs.	£ s. d.	s.

KITTICOOLOA, REEDY CREEK.

Battery treatment	45 0 0	20 9 0	65 0 0	—
Total	45 0 0	20 9 0	65 0 0	29

WADNAMINGA (Mr. O. W. ALLANSON).

Virginia (tailings cyanided)	1,413 0 0	378 15 0	790 3 8	—
Total	1,413 0 0	378 15 0	790 3 8	11½

DELORAINÉ GOLD MINE.

Battery treatment	1,055 0 0	876 5 0	3,220 19 10	—
Total†	1,055 0 0	876 5 0	3,220 19 10	61

* Sands only.

† Also 1·57 tons copper, worth £113 18s. 2d.

**TOTAL BATTERY AND CYANIDE RETURNS FROM ALL PLANTS
FOR SIX MONTHS ENDED JUNE 30TH, 1914.**

Name.	Ore Treated.			Gold Bullion Recovered.			Value.			Yield per Ton, in Shillings.
	Tons.	cwts.	qrs.	Ozs.	dwt.	grs.	£	s.	d.	s.
Tarcoola	316	0	0	631	19	14	2,224	18	8	140 $\frac{3}{4}$
Glenloth	196	0	0	81	6	5	264	19	8	27
Petersburg	235	11	0	154	5	11	567	18	3	83 $\frac{5}{8}$
Mount Torrens	81	0	0	18	10	16	62	15	11	15 $\frac{1}{2}$
Kitticoola	45	0	0	20	9	0	65	0	0	29
Wadnaminga	1,413	0	0	378	15	0	790	3	8	11 $\frac{1}{4}$
Deloraine	1,055	0	0	876	5	0	3,220	19	10	61
Total	3,341	11	0	2,161	10	22	7,196	16	0	43

COPPER.

AVERAGE MONTHLY PRICE OF COPPER, JANUARY TO JUNE, 1914.

	Standard.				Best Selected.		
	£	s.	d.		£	s.	d.
January	64	8	0	..	69	16	1
February	65	8	5	..	70	8	9
March	64	8	2	..	69	2	9
April	64	16	5	..	69	7	2
May	63	5	10	..	68	3	4
June	61	9	3	..	66	2	3
Average for the six months.....	63	19	4	..	68	16	8 $\frac{1}{2}$

RANGE OF PRICES.		£	s.	d.
February 4th.....		66	17	6
June 27th		60	2	6

AVERAGE PRICE OF STANDARD COPPER FOR THE LAST TEN YEARS.

	£	s.	d.		£	s.	d.
1904	59	0	7	1909	58	17	2
1905	64	16	10	1910	57	3	3
1906	87	8	10	1911	56	1	10
1907	82	1	11	1912	73	1	3
1908	60	0	10	1913	68	5	8

Average for the 10 years, £66 13s. 10d.

REPORTS ON BORING OPERATIONS.

BORING OPERATIONS AT THE YELTA AND POONA MINES, MOONTA

Report by Mr. A. W. Matthews, Foreman.

No. 8 bore, Yelta Mine, was started on January 22nd and completed on March 31st. The plant was then dismantled and removed to the Poona Mine, Moonta, and No. 1 bore started April 21st and carried down to 522ft. Still in progress.

Particulars of Boring.

NO. 8 BORE, YELTA MINE.

Started boring 160ft. S. of Scott's shaft and about opposite Hancock's shaft angle 15 in 100; $3\frac{1}{2}$ in. bit.

Surface	
to	Loam and limestone.
1ft. 6in.	
to	Very hard and broken country rock.
290ft.	
to	Blue country rock showing a little iron pyrites.
331ft.	
to	Quartz showing a little yellow sulphide.
33ft.	
to	Broken country rock.
427ft.	
to	Quartz.
427ft. 2in.	
to	Red country.
435ft.	
to	Lode showing yellow sulphide.
436ft.	
to	Country.
449ft.	
to	Lode formation showing a little sulphide.
451ft.	
to	Broken country rock.
528ft.	
to	Country showing seams of yellow ore.
529ft 6in.	
to	Broken country.
542ft.	
Boring discontinued.	

NO. 1 BORE, POONA MINE.

Position of bore, 236ft. back from main shaft; angle 10 in 100. Started boring, with $3\frac{1}{2}$ in. bit, and on account of broken nature of surface reamed bore out to $4\frac{1}{2}$ in. to a depth of 13ft.

Surface	
to	Loam.
1ft. 6 in.	
to	Limestone, sandstone, and broken rock.
36ft.	
to	Broken red country.
135ft.	
to	Quartz.

- to Very broken country.
 155ft. to Small veins of iron pyrites.
 156ft. to Broken country.
 223ft. to Quartz showing mundic and yellow sulphide.
 224ft. to Lode formation showing splashes of sulphide.
 235ft. to Quartz and lode matter carrying veins of yellow ore.
 237ft. to Formation.
 242ft. to Quartz and lode matter showing sulphide freely.
 246ft 8in. to Very hard and broken country rock.
 259ft. to Country showed small quartz veins carrying a little iron pyrites and a few specks of yellow ore.
 266ft. to Broken red country.
 293ft. to Mundic.
 293ft. 4in. to Very hard red country.
 432ft. to Quartz showing a little sulphide.
 432ft. 4in. to Hard red country.
 522ft.

The assay results from the formation drilled through from 223ft. to 246ft. 8in. are as follows:—

	Gold.	Silver.	Copper.
			per cent.
No. 1. 223ft. to 224ft. 6in., drill core	Nil	Nil	2.8
No. 2. 235ft. to 237ft., drill core	Nil	Nil	5.8
No. 3. 242ft. to 243ft. 8in., drill core	Nil	Nil	2.1
No. 4. 242ft. to 246ft. 8in., drill core	Nil	Nil	3.2
No. 5. 242ft. to 246ft. 8in., drill core	2½dwts. per ton	Nil	4.4
No. 6. Sediment while drilling from 242ft. to 246ft. 8in.	1dwt. per ton	Nil	10.9
No. 7.	1dwt. per ton	Nil	10.4

Boring still in progress. Total boring, 1,064ft.

BORING OPERATIONS AT THE AJAX MINE, NEAR WAUKARINGA, AND AT THE PARADISE COAL COMPANY'S PROPERTY, NEAR HIGHBURY.

Report by Mr. C. F. Duffield, Foreman.

No. 2 bore on the Ajax lease was continued from 332ft. to 458ft., the country passed through being chiefly calcareous slate with bars of diorite and small seams of quartz.

The plant was then removed to the Alma Mine, Waukaringa, and a hole put down to cut the lode at 500ft.; angle of bore 30ft. in 100ft. The country passed through being as follows:—

Surface	
to	Surface loam, limestone rubble.
5ft.	
to	Blue slate country with small bars of diorite.
385ft.	
to	Diorite slate country.
511ft.	
to	Quartz.
512ft.	
to	Ferruginous sandstone country.
528ft.	
to	Lode material.
529ft.	
to	Soft blue slate footwall.
533ft.	
to	Hard diorite.
559ft.	
to	Soft slate.
576ft.	
to	Sandstone country.
591ft.	
to	Slate.
602ft.	
to	Yellow sandstone.
607ft.	
to	Seam of iron pyrites.
607ft. 4in.	
to	Soft blue slate.
612ft.	
to	Diorite.
648ft.	
to	Red sandstone.
654ft.	
to	Hard diorite.
657ft.	
to	Slate and diorite.
670ft.	
to	Sandstone with quartz seams and slate showing pyrites.
692ft.	
to	Blue slate.
725ft.	
to	Red sandstone.
726ft.	
to	Slate country.
730ft.	

The plant was then dismantled and removed to Adelaide.

BORE ON THE PARADISE COAL COMPANY'S PROPERTY, NEAR HIGHBURY.

Boring operations were started on May 28th, using a 6 $\frac{3}{4}$ in. Calyx bit. The country passed through being as follows :—

Surface	
to	Sandy loam.
2ft.	
to	Yellow clay.
4ft.	
to	Sandstone.
18ft.	
to	Drift sand.
83ft.	
to	Mixture of sand and clay.
106ft.	
to	Brown sand, then 2in. ironstone band.
150ft.	
*to	Brown coal material, with 3in. seam of shale at 186ft.
193ft.	
to	Pipeclay.
290ft.	
to	Soft clay slate.
300ft.	
to	Cambrian rock.
303ft.	

Total boring for half-year being 1,159ft.

* Vide detail report by the Government Géologist, page 40.

SUBSIDIES.

The Legislature provided in the Mining Act, 1893, and in previous measures for the encouragement of Mining.

The following schedule shows what subsidies have been paid from the inception of the system to June 30th, 1914, and the sums repaid. In the ordinary way these repayments are made from profits—50 per cent. of such profits being devoted to repayments. In two instances only have the profits won enabled full repayments to be accomplished—the Crystal Mine, at Echunga, which repaid £76 7s. 6d. from that source, and the once-famous New Alma and Victoria Mine, Waukaringa, which repaid in full the first subsidy, £3,000. The remainder of the recoveries was derived from sales of mining plant held as security. The total subsidies advanced is £59,012 13s. 6d. of which £7,597 5s. 4d. has been recovered, leaving a debit balance of £51,415 8s. 2d. Portion of this outstanding debt is represented by machinery that has fallen into the hands of the Government; add to this the value of the metals won, and the State in general will probably have benefited beyond the money value of the debit balance.

STATEMENT OF SUBSIDIES PAID FROM COMMENCEMENT TO
JUNE 30TH, 1914.

Name of Company or Person to whom Subsidy Granted.	Locality.	Amount Advanced.	Amount Repaid.
		£ s. d.	£ s. d.
Adelaide Crushing, Grinding, and Amalgamating Mill Co.	—	100 0 0	—
Algebuckina Gold Mining Syndicate	Algebuckina	52 10 11	52 10 11
Alma Extended Gold Mining Co.	Waukaringa	3,000 0 0	172 5 0
Backhouse, T. S.	Worturpa	100 0 0	—
Barossa Enterprise Gold Mining Coy.	Barossa, Hundred of ..	232 2 3	—
Belalie Copper Mining Syndicate	Bundaleer	392 12 3	—
Beltana Rapid Ore Treatment Syndicate....	Near Beltana	353 5 0	—
Bevilaqua & Angel	Palmer (near)	57 18 0	—
Bird-in-Hand Gold Mining Co., Ltd.	Woodside	3,000 0 0	—
Blackfellow's Creek Gold Mining Co., Ltd. .	Kuitpo, Hundred of ..	660 6 7	35 0 0
Callington Copper Mining Co.	Callington	148 8 7	—
Cockburn Copper Mining Co., N.L.	Mutooroo	273 18 5	173 13 8
Commonwealth Silver-lead Co., Ltd.	Strathalbyn, Hund. of	750 0 0	52 17 9
Copper Hill Mining Co., N.L.	Kadina	391 15 6	115 0 0
Cornwall Copper Mining Syndicate, N.L. .	Kadina, Hundred of ..	500 0 0	—
Countess of Jersey Gold Mining Co., N.L. .	Wadnaminga	321 0 0	—
Cowell Consolidated Silver and Copper Mines	Hds. Miltalie & Hawker	133 6 6	—
Currency Creek Copper Mining Co.	Currency Creek	28 6 5	20 0 3
Crystal Gold Mining Co.	Echunga	563 17 6	176 7 6
Davis, A. (Doris Fabian Mine)	Leighs Creek, Near ..	149 12 6	—
Ding Dong Copper Mining Syndicate	Kanmantoo, Hund. of	124 0 4	—
Duke of Cornwall Gold Mining Syndicate ..	Mount Pleasant	458 17 4	43 10 0
Eagle Silver Mining Co., Ltd.	Glen Osmond	500 0 0	—
Ediacara Consols Silver Mining Co., N.L. .	Ediacara	651 12 1	465 17 0
Enterprise Copper Mining Co., N.L.	Barossa, Hundred of ..	150 0 0	9 16 0
Enterprise Excelsior (Barossa Amalgamated)	"	2,000 0 0	—
Eureka Gold Mining Co., Ltd.	Woodside	1,500 0 0	—
Fifth Creek Central Silver and Copper Mining Co., N.L.	Fifth Creek	253 2 4	—
Fortress Hill Mining Syndicate	Fortress Hill	60 0 0	—
Glenloth Mining, Battery, & Options Co., N.L.	Glenloth	515 4 7	515 4 7
Glenloth Wells Pioneer Blocks Co., Ltd.	"	100 0 0	22 18 5
Gumeracha Gold Mining Syndicate	Gumeracha	75 0 0	—
Golden Point Claims	Wonna	50 0 0	—
Great Ironclad Gold Mining Co.	Teetulpa	218 6 9	—
Hakendorf, C. H., and Williams, J. (Glen- markie Mine)	Glenloth	221 17 6	—
Hamley Copper Mining Co.	Wallaroo	2,000 0 0	—
Homeward Bound and Klondyke Gold Mines, N.L.	Mannahill	192 17 1	8 8 9
Heithersay, J. (Kirkeeks Treasure Mine) ..	Waukaringa	502 12 0	—

STATEMENT OF SUBSIDIES PAID—continued.

Name of Company or Person to whom Subsidy Granted.	Locality.	Amount Advanced.	Amount Repaid.
		£ s. d.	£ s. d.
Hunter Bros. (Lady Millicent Mine and Nuccaleena Mines)	Mochatoona	366 12 4	—
Ireby Gold Mining Syndicate	Mount Grainger	35 4 3	—
Kanmantoo Copper Mines Syndicate, N.L.	Kanmantoo	150 2 1	—
Kingsborough, W. A. (Benowrie Mine)	Near Cutana	30 15 0	—
Kirkeek's Treasure Gold Mining Co.	Waukaringa	691 8 1	—
King's Bluff G.M. Co., N.L.	Olary	622 0 8	—
Kohinoor Gold Mining Co., N.L.	Kangaroo Island	100 0 0	—
Kohinoor Mine (H. G. Taylor)	"	200 0 0	—
Lady Alice Gold Mining Co.	Barossa, Hundred of	1,797 2 3	—
Lady Franklin Syndicate	Port Lincoln	200 0 0	40 0 0
Leigh's Creek South Coal Mining Co., N.L.	Leigh's Creek	95 16 4	95 16 4
McMurtie's Claims	Kuitpo, Hundred of	199 19 11	—
Mingary Gold Mining Co.	New Luxemburg	400 0 0	—
Montacute Gold and Copper Mining Co., N.L.	Sixth Creek	400 0 0	—
Mount Victoria Mine	Bimbowrie	50 0 0	—
Mount Malvern Silver Mining Co.	Blackwood	491 3 6	—
Mount Malvern Silver-lead Mining Co., N.L.	Clarendon	1,347 15 3	—
Mount Pangæus Gold Mining Co.	Hahndorf (near)	56 1 4	—
Mount Monster Gold Mining Syndicate	Kuitpo, Hundred of	350 0 0	1 0 0
Mt. Grainger Ironclad Gold Mining Syn., Ltd.	Mount Grainger	21 18 10	—
Mount Torrens Gold Mining Co.	Mount Torrens	1,000 0 0	—
Mount Remarkable Mining Co., Ltd.	Wongyarra, Hund. of	122 8 1	15 0 0
Musgrave Ranges Prospecting Association ..	Musgrave Ranges	47 2 0	—
Mount Painter Corundum and Gem Syndicate ..	Mount Painter	47 3 1	—
Morning Star Gold Mining Co.	Teetulpa	68 4 6	—
Mutooroo Copper and Silver Mining Co., Ltd.	Mutooroo	500 0 0	500 0 0
Nackara Proprietary Copper Mining Co., N.L.	Nackara	100 0 0	—
Nackara Proprietary Gold Mining Syndicate ..	Nackara	100 0 0	—
New Banksia Gold Mining Syndicate	Nairne	250 0 0	—
New Alma and Victoria Gold Mining Co., Ltd.	Waukaringa	3,000 0 0	3,000 0 0
New Ajax Consolidated Gold Mining Co., N.L.	"	750 0 0	—
New Era Gold Mining Co., Ltd.	Woodside	1,000 0 0	—
New Glenloth Battery and Mining Co., N.L.	Glenloth	750 0 0	—
New Medora and Grainger Gold Mines Syn., N.L.	Mcunt Grainger	1,421 9 9	—
New Mingary Gold Mining Co.	New Luxemburg	250 0 0	—
New Mount Grainger Gold Mines, N.L.	Mount Grainger	393 7 1	220 0 0
Northern Mining and Smelting Co., N.L.	Mount Fitton	350 0 0	3 12 6
North Nairne Gold Mining Co.	Nairne	500 0 0	—
North-West and West Australian Pros. Co.	North-west of S.A.	104 9 7	—
North-West Prospecting Association, N.L.	Tarcoola	150 0 0	—
Nil Desperandum Teetulpa Devt. Co., N.L.	Teetulpa	64 14 4	20 5 6
Nilpena Copper Mining Co., Ltd.	Blinman	290 5 3	—
Onkaparinga Dredging and Mining Co., and Echunga Propy. Hydraulic Gold Sluicing Co.	Biggs' Flat	1,050 0 0	700 0 0
Paull's Consolidated Copper Propy., N.L.	Burr Well	525 0 0	13 9 0
Parara Mining Co., N.L.	Maitland	571 3 6	—
Paringa Mining Syndicate	Callington	399 16 8	244 0 0
Paringa and West Kanmantoo Consolidated Copper Mine, N.L.	"	1,144 3 4	10 5 0
Pioneer Gold and Copper Mining Syndicate ..	"	95 15 6	—
Polmear, W. J. L.	Kadina	800 0 0	—
Queen Bee Mining Co., N.L.	New Luxemburg	250 0 0	250 0 0
Quorn Manganese and Silver Mining Co.	Quorn	10 9 10	—
Rapid Bay Silver Mining Co., N.L.	Yankalilla, Hund. of	136 2 4	—
Robertstown Bright Silver Lead Mines	Hd. Bright	170 5 11	—
Royal Charlie Gold Mining Co.	Mannahill	153 18 5	—
Rees, R., Ajax Mine	Waukaringa	604 14 5	—
Stainbank, A. T.	Fifth Creek	70 14 11	—
Sliding Rock Copper Proprietary, N.L.	Sliding Rock	2,000 0 0	27 17 0
Tarcoola Blocks Gold Mining Co., Ltd.	Tarcoola	3,995 5 2	150 19 11
Tarcoola Enterprise Gold Mining Co., N.L.	"	100 0 0	19 10 4
Tarcoola Proprietary Gold Mines, N.L.	Tarcoola	150 4 4	9 15 0

STATEMENT OF SUBSIDIES PAID—*continued.*

Name of Company or Person to whom Subsidy Granted.	Locality.	Amount Advanced.			Amount Repaid.		
		£	s.	d.	£	s.	d.
Teetree Gully Gold Mining and Pros. Assn.	Teetree Gully	234	5	7	—	—	—
Teetulpa Mining and Crushing Co.	Teetulpa	349	11	4	—	—	—
Teetulpa Prospecting Syndicate	"	49	15	0	—	—	—
Tumby Bay Copper Mining Co., N.L.	Hutchison, Hund. of ..	454	3	5	—	—	—
Utica Copper Mining Co. N.L.	Burra	21	12	7	—	—	—
Victoria Hill Amalgamated Gold Mining Syn.	Barossa, Hundred of ..	38	12	6	—	—	—
Victoria Tower Mining Co., N.L.	Mannabill	345	18	9	90	0	0
Warrakimbo Propy. Copper Mining Synd. ..	Barndioota, Hundred of	220	16	2	—	—	—
Warra Warra Propy. Copper Mines, N.L. ..	Farina	322	4	11	322	4	11
Watt's Gully Gold Mining Co.	Gumeracha	50	0	0	—	—	—
Watt's Gully Reef Claims	Gumeracha	50	0	0	—	—	—
Wolters, F. C., & Co.	Echunga	25	0	0	—	—	—
Wallaroo Central Mining Co., N.L.	Kadina	500	0	0	—	—	—
Westward Ho Mine (Dr. H. Dixon)	Mannabill	1,000	0	0	—	—	—
Wohler, H., & Co.	Myponga	20	0	0	—	—	—
Wheal Turner Copper Mining Co., Ltd.	Prospecting on proposed line to Queensl'd Border	1,000	0	0	—	—	—
Winnininnie Gold & Silver Propy. Co., N.L.	Winnininnie	86	3	6	—	—	—
Woodside Boring and Mining Syndicate	Woodside	422	17	11	—	—	—
Worturpa Exploration and Mining Co., Ltd.	Worturpa	800	0	0	—	—	—
Yelta New Copper Mining Co., N.L.	Wallaroo	1,000	0	0	—	—	—
Young Bullfinch Gold Mining Co., N.L.	Talunga, Hundred of	146	3	4	—	—	—
Totals	—	59,012	13	6	7,597	5	4

ACCIDENTS IN MINES AND QUARRIES.

A gratifying feature of our mining operations in mines and quarries is the infrequency of serious accidents. Act No. 858 of 1904, bringing quarries in the same category as mines as regards the control of the Chief Inspector of Mines has been effective in safeguarding the interests of quarry-men. The following table gives the number of accidents in mines and quarries since passing of the Act:—

ACCIDENTS IN MINES AND QUARRIES.

ACCIDENTS IN MINES.				ACCIDENTS IN QUARRIES.			
Year.	Total Number of Accidents Reported.	Number of Persons Injured.	Number of Persons Killed.	Year.	Total Number of Accidents Reported.	Number of Persons Injured.	Number of Persons Killed.
1904	5	1	4	1904	1	1	1
1905	3	1	3	1905	—	—	—
1906	5	—	3	1906	1	1	—
1907	8	4	6	1907	3	1	2
1908	5	4	1	1908	—	—	—
1909	6	5	1	1909	1	1	—
1910	5	3	3	1910	2	1	1
1911	2	—	2	1911	—	—	—
1912	3	2	1	1912	2	—	2
1913	10	8	2	1913	—	—	—
Jan. } 1914	1	1	—	Jan. } 1914	2	2	—
June }				June }			

ASSAYS AT SCHOOL OF MINES.

NUMBER OF ASSAYS MADE FOR PUBLIC PURPOSES AT THE
SCHOOL OF MINES ASSAY DEPARTMENT DURING THE
SIX MONTHS ENDED JUNE 30TH, 1914.

	1914.					
	January.	February.	March.	April.	May.	June.
Department of Mines	54	55	78	170	31	89
Public assays	80	129	82	51	85	97
Totals	134	184	160	221	116	186

DECENNIAL RETURN SHOWING OUTPUT AND VALUE OF VARIOUS
METALS AND MINERALS PRODUCED IN SOUTH AUSTRALIA SO
FAR AS CAN BE ASCERTAINED.

Year.	GOLD.		SILVER.		SILVER LEAD ORE.		COPPER.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Ounces.	£	Ounces.	£	Tons.	£	Cwts.	£
1904	17,897	76,025	—	—	—	—	125,560	382,356
1905	10,983	45,853	—	—	—	—	130,959	426,511
1906	8,037	27,000	801	104	—	—	164,160	718,609
1907	5,609	20,540	5,845	780	1,000	11,000	158,620	690,000
1908	2,908	12,300	—	—	900	9,000	112,554	338,000
1909	7,111	30,206	1,660	167	70	416	113,940	334,584
1910	6,603	28,000	6,250	625	25	22	102,040	306,120
1911	3,537	15,000	1,400	140	—	—	118,440	332,530
1912	6,592	28,000	2,700	326	—	—	125,900	461,500
1913	6,556	27,800	2,650	300	153	1,100	143,222	488,986
Totals....	—	310,724	—	2,442	—	21,538	—	1,479,166

Year.	COPPER ORE AND REGULUS.		LEAD.		IRONSTONE FLUX.		LIMESTONE FLUX.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	£	Cwts.	£	Tons.	£	Tons.	£
1904	3,051	24,597	—	—	46,687	27,091	43,440	6,516
1905	2,563	28,434	1,040	369	84,483	48,577	44,498	4,791
1906	—	—	1,000	550	75,226	33,852	31,940	4,791
1907	—	—	—	—	84,600	38,100	31,100	5,800
1908	—	—	—	—	88,000	39,600	29,500	6,000
1909	1,230	4,003	140	90	16,120	8,296	13,765	2,464
1910	—	*9,350	400	260	46,210	21,945	18,600	3,720
1911	—	*11,103	—	—	42,300	26,400	28,700	7,175
1912	—	*10,192	—	—	42,200	26,375	50,600	12,500
1913	—	*8,308	—	—	60,658	37,911	44,300	11,075
Totals	—	95,987	—	1,269	—	308,187	—	64,832

Year.	PHOSPHATE ROCK.		CRUDE SALT.		OTHER METALS AND MINERALS.	Total Value.
	Quantity.	Value.	Quantity.	Value.	Value.	
	Tons.	£	Tons.	£	£	£
1904	3,000	3,000	40,000	12,000	198	531,783
1905	5,000	5,000	32,500	13,000	1,261	573,796
1906	5,850	5,850	55,000	27,500	2,209	820,465
1907	8,000	8,000	75,000	37,500	2,500	814,220
1908	11,000	11,000	75,000	37,500	4,500	457,900
1909	3,772	3,697	51,407	25,594	3,873	413,390
1910	5,200	5,200	54,000	27,000	†13,600	415,342
1911	5,800	5,800	63,000	40,600	†11,319	450,054
1912	6,100	6,100	64,300	40,187	†10,490	595,670
1913	5,950	6,545	65,000	48,750	†11,851	642,626
Totals	—	60,192	—	309,631	61,801	5,715,746

* Bluestone, £5,980; Sulphuric Acid, £3,370.

" £4,163 " £6,940.

" £2,550 " £7,642.

" £325 " £7,983.

† Including Gypsum, £9,000; Pyrites, £3,270.

" £7,275; " £2,580.

" £9,000.

" £5,362.

rib to appear on the cleavage surfaces, but is not regarded as a detriment to the few flags in which such veins occur. These veinlets, which are locally known as "seams," are inclined to the bedding-planes at angles other than right angles.

The final result of the weathering of the slate is a reddish soil, in which a little white travertine limestone occurs. Beneath the soil, which is from 1ft. to 3ft. in depth, there are in most places several feet of friable slate which gradually becomes more and more compact. The quarries of the Mintaro Slate and Flagstone Company are situated on beds, the dip of which is 22° , and these beds weather in such a manner that no residual blocks of stone remain in the surface soil; but the more steeply-inclined beds to the E. weather to a soil in which large fragments of undisintegrated rock occur. The depth of weathering is rather variable. The stone occurring in the Mintaro Slate and Flagstone Company's quarries at a less depth below the surface than 25ft. is regarded as overburden and is totally rejected. Between depths of 25ft. and 40ft. the weathered stone is culled out and thrown away, and below 40ft. the waste due to the influence of weathering is almost negligible. The exposure at Mr. Laycock's quarry is not yet sufficiently extensive to fully determine the depth of weathering and its effect on the character of the stone. The flagstones obtained from this quarry have been won from relatively shallow depths, and there are no exposures of unweathered stone with which to compare them.

The divisional planes, whether actual or potential, which are present in the slate beds, and which determine its suitability for working, are the results of earth movements since the Cambrian epoch. These divisional planes are only fully revealed by extensive workings, and for this reason it is always a matter of difficulty to determine the commercial value of the slate beds during the earlier stages of prospecting.

The cleavage of the slate follows the bedding planes, and the positions of the planes along which the slabs of slate will cleave are marked by dark-colored bands which are only visible on close inspection. The spacing of these cleavage planes—at intervals of rarely less than an inch—is such that flagstones fashioned from the stone are free from danger of scaling. The cleavage surfaces are on the whole remarkably smooth and even, but on some faces there are small wrinkles known as "feather marks," which have no constant orientation. These markings are not serious blemishes in the flagstones.

The joint planes, which cut across the bedding planes of the belt of slate worked by the Mintaro Slate and Flagstone Company, are for the most part to be grouped into two series —

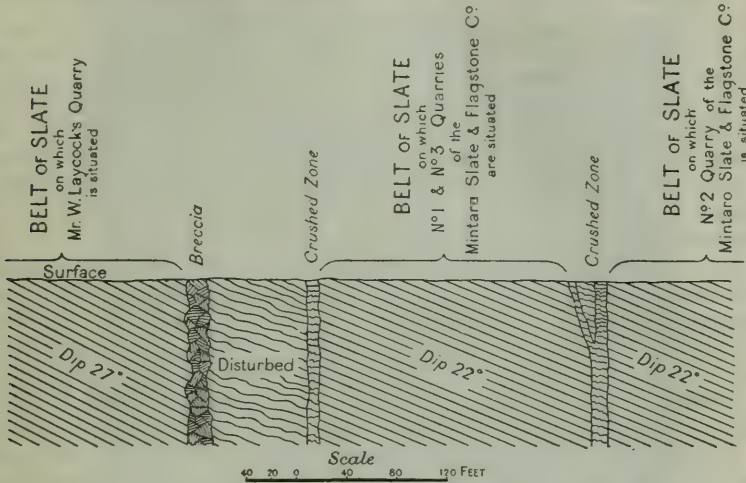
- (1) A meridional series, the strike of which is within a few degrees of the magnetic meridian;
- (2) A series the strike of which varies between the bearings N. 67° W. and N. 86° W.

The major joint planes in these quarries are continuous from the surface to the lowest level of the workings and are practically vertical. Parallel to them and near the main joints are similar joint planes which traverse some of the beds, but do not extend continuously for any considerable vertical distance. In addition there are subsidiary joints, irregularly oriented, at some places where the main N.-S. and E.-W. joints intersect. These, however, do not as a rule penetrate far into the beds.

The "grain" of the slate in these quarries runs in a meridional direction, and is utilised in the work of quarrying, but the stone is stated to be of practically equal strength, both with and across the grain.

The stone raised from shallow depths can readily be split as soon as it is quarried, but the more deeply seated stone must be stacked on its edge for some months before the best possible results can be obtained from it. Slabs from a depth of 120ft. from the surface may require seasoning for a period of 12 months. For this reason it is necessary for the company to carry large stocks of slate in the yards. Unseasoned stone is not sent away from Mintaro.

The principal quarries are situated on a belt of slate which has a total width of not less than 300ft., and which has been partly proved for a length of over 15 chains.



This belt may extend to the W. beyond the W. wall of the No. 2 quarry, but there are no exposures that may serve to indicate how much greater is the workable width in that direction. The No. 2 quarry is situated on the W. part of the belt which has not been worked elsewhere. It has a maximum width of 100ft., and is bounded on the E. by a vertical zone of crumpled slate, 10ft. to 15ft. in width. This disturbed zone runs from the surface to the bottom of No. 2 quarry. Its strike is meridional, and it constitutes the E. wall of the quarry. Near the S. end of the opening it is a simple break, but, as work proceeded N., it was found to bifurcate, the slate between the two branches being somewhat disturbed also.

This zone of disturbance is probably identical with that which forms the W. wall of No. 3 quarry to the S. To the E. of the break the slate possesses the same strike and dip as in No. 2 quarry, and on this E. portion of the belt are located No. 1 and No. 3 quarries. The full width of workable slate in these quarries is 200ft. This latter body of workable stone is bounded on the E. by a crushed zone approximately parallel to that mentioned above.

Still farther to the E., at a distance of 81ft. from the E. zone of disturbance, is situated a fault breccia which marks the E. limit of the slate which possesses a dip of 22°. The slate to the E. of the breccia where exposed in a creek bed in section 178, hundred of Clare, and also in Mr. Laycock's quarry, has a dip of 27°, also to the W.

The outstanding structural feature of the belt of productive slate worked by the Mintaro Slate and Flagstone Company is the remarkable constancy of its dip at 22°, in spite of the well-defined zones of dislocation which traverse it.

THE COMPANY'S QUARRIES.

(1) The Mintaro Slate and Flagstone Company, Limited, possesses a block of land, the total area of which is a little over 60 acres. There are three quarries in the property, only one of which (No. 3) is now being worked.

The flagstones were first found outcropping in the bed of a creek which runs through section 178 of the hundred of Clare, over 50 years ago, and some of the slate was exhibited in London in 1861. The No. 1 quarry (also known as Priest's Quarry) was the first worked, being adjacent to the site of the original discovery.

This quarry is said to be 80ft. deep, and occupies an area of approximately 2,000 square yards. It is now full of water, which is used in the dressing plant.

The No. 2 quarry is a much larger excavation, the area covered being about 7,000 square yards, and the deepest part being 130ft. below the surface. This quarry is situated to the N. of the road traversing the property, and from it the greater part of the flagstone marketed has been obtained. The workings do not extend in a W. direction for the full width of the workable slate. Nor have the quarry benches been carried to the limits of the valuable stone in either a N. or S. direction. To the E. of the crushed zone which forms the E. wall of the quarry, lies the belt of slate which is worked in the No. 1 and No. 3 quarries. No work is at present being carried on in No. 2 quarry, for the reason that the face was found to be too narrow to supply the increasing demand for the flagstone, and it was considered better policy to open up a fresh quarry with a greater width of working face.

The No. 3 quarry was started with this object, and will provide a face having a horizontal width of 200ft., or a width of 217ft. measured in the plane of the beds. At the present time this quarry, which is immediately to the N. of that which was first opened up, is producing some slate, but no small part of the quarrying operations are still concerned with the stripping of overburden. The angle of dip of the slate is such that when one of the beds is continuously exposed for the whole workable width the depth of the quarry will be at least 80ft. on the W. wall.

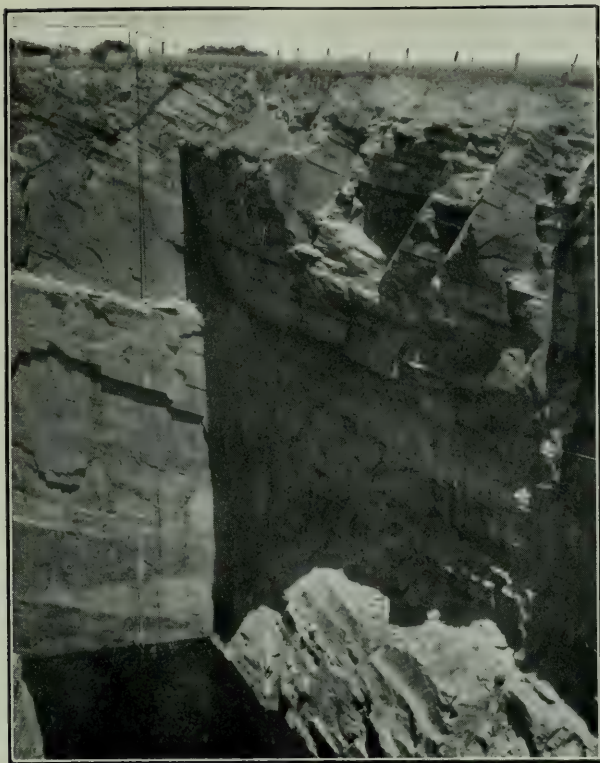
The probable reserves of unworked stone within the limits of the company's property are enormous, and may be expected to extend far beyond the limits of the present openings, which occupy but a small fraction of the area comprised in the property.

All the mining and splitting is done by hand labor. In plugging the slate steel plugs and iron feathers are used. The plugs are driven from 6in. to 1ft., but no deeper, for the reason that the slate tends to break with a bevel edge rather than at right angles to the bedding planes if deep holes are used. The No. 3 quarry is equipped with a steam crane of 10 tons capacity for hauling the flags from the quarry, and a handpower crane of 5 tons capacity for loading the trollies. The No. 2 quarry is equipped with a steam crane of 7 tons capacity, and a handpower crane capable of lifting 2 tons for loading the wagons that carry the slate to the railway. The stone exported from the State is sent away with hammer-dressed edges, but most of the flagstones, &c., sold in South Australia are dressed in the company's yards at Mintaro. Two Allan oil engines of 22-H.P. each supply the power. One engine drives two sets of eight saws each and the carborundum rubbing cylinder. The other engine drives two sets of eight saws each and a planing machine, and to this unit a table rubbing machine will shortly be added. The saws used are of 10-gauge mild steel plate, 10in. wide and from 9ft. to 14ft. in length. Sand obtained from Glenelg is the abrasive supplied to the saws.

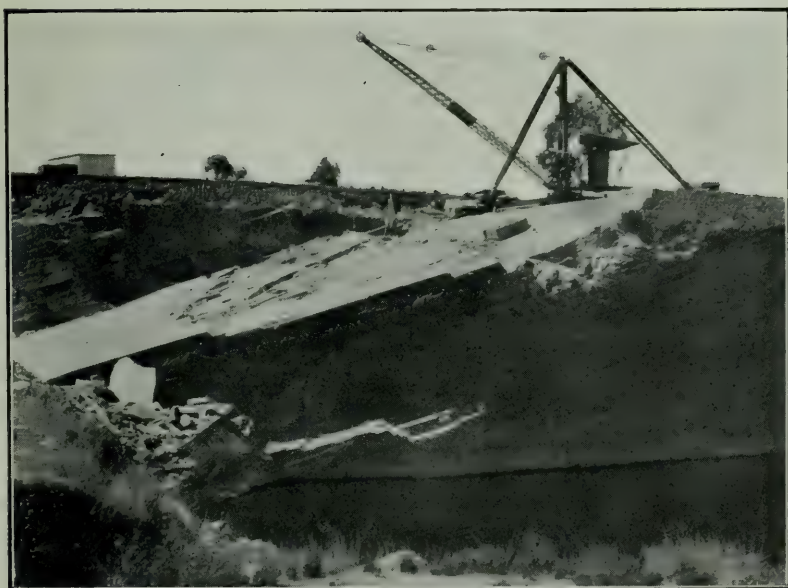
The planing machine is a single-acting machine with a bed 3ft. 6in. wide and a travel of 14ft. It is used for "nosing" (i.e., rounding the edges off) the slate, and is found capable of nosing 210ft. in a day, whereas one man by hand labor can nose from 35ft. to 40ft. in a day.

It is the object of the company to carry as large stocks of slate as possible—a necessary provision in view of the increasing demand for the slate. At the stock-taking on December 31st, 1913, it was estimated that the stocks held at Mintaro were then 50,000 square feet of slate 2in. thick, and 65,000 square feet of slate 1½in. thick. In the framing of this estimate all sizes of unworked stone have been expressed in the thicknesses mentioned. In addition, it is estimated that 700 tons of flagstone were at the time in stock in the Melbourne yards belonging to the company.

The sizes of large flagstones sent out are limited by the dimensions of standard trucks, and no flagstones measuring more than 14ft. 6in. by 7ft. 6in. are dispatched by rail, although larger ones can be supplied by the quarry. The thicknesses most in demand are 1½in. and 2in., but the company quotes prices for flagging of all thicknesses between 1in. and 3in.



Mintaro Slate and Flagstone Coy.'s No. 2 Quarry.



Mintaro Slate and Flagstone Coy.'s No. 3 Quarry and
No. 1 Quarry (full of water).

The smallest stock size is that which is used for grave kerbing, the dimensions being 3ft. 6in. by 7in. in width. Small sizes have been employed in special work, but there is at the present time no regular demand for them. The uses to which the slate is put are manifold, the principal articles manufactured being hearths, sills, steps, kerbing stones, shelves, cricket pitches, troughs, tanks, vats, billiard table tops, ledgers and vault covers, slabs for lavatories, paving flags and switch-boards.

As in all quarries in which slate is worked, there is inevitably a considerable amount of waste material produced. The upper part of the slate beds is so affected by weathering that it is of no value whatever; but there is some unavoidable waste of unweathered material, and it should be the first object of the company to ascertain the percentage of waste at each stage of mining and dressing operations.

The Mintaro Slate and Flagstone Company has hitherto found its best market in Melbourne, and it is now taking steps to open up a branch in Sydney.

Tests were made on the slate from these quarries in March, 1891, in the engineering laboratory of the University of Melbourne by Professor W. C. Kernot, with the following results:—

Description.	Span.	Breadth.	Depth.	Breaking Load.	Ultimate Deflection.	Remarks.
1. Beam of Mintaro slate	36"	9.84"	2.08"	1,935lbs.	.05"	Clean uniform fracture
2. Portion of No. 1 slate	18"	9.84"	2.08"	4,270lbs.	.03"	"
3. Other portion of No. 1	18"	9.80"	2.07"	4,575lbs.	.03"	"

The value of the flagging produced annually from the quarries of the Mintaro Slate and Flagstone Company has shown a steady increase, and during the year 1913 amounted to over £7,000. The total value of the flagstones produced since July, 1893, is £64,443.

The flagstones from these quarries have been extensively used for street paving and have given entire satisfaction wherever they have been employed. The Town Clerk of Adelaide advises that the wear of the city footpaths paved with Mintaro flagging has been $\frac{1}{4}$ in. in 14 years, this measurement having been made at a distance of 3ft. from the building line, where the pedestrian traffic has been the heaviest.

This flagging is specified wherever such material is required in Government buildings in South Australia.

MR. W. LAYCOCK'S QUARRY.

This quarry was first opened up about two years ago in the hope of locating another deposit of workable flagstone. The quarry is situated to the E. of the belt in which the Mintaro Slate and Flagstone Company's quarries are located, and the beds of slate exposed in it dip to the W. at 27° .

While a considerable amount of work has been done, and a maximum depth of 50ft. has been reached, it cannot be said that the existing excavation is a conclusive test of the country lying to the E. of the main productive belt. The steeper dip of the slate in this quarry is in no way a mark of inferiority of the material. Of much greater importance in the determination of the value of the flagging are the nature of the cleavage surfaces and the disposition of the joints. In the past there has been some irregularity in the cleavage surfaces and the main joints have been spaced at rather narrow intervals, but these phenomena may prove local if more extensive workings are opened up. The main joints have a strike bearing N. 28° E. and dip to the S E. at 52° .

The greater part of the flagging hitherto quarried has been won from shallow depths, and exhibits the same properties as the upper part of the slate in the larger quarries to the W. The best stone obtained comes from no more than 15ft. beneath

the surface, and these beds are not exposed in depth, being stratigraphically below those seen at the deepest part of the quarry.

Some 70 tons of slate have been sent to Adelaide, where the work of dressing has been carried out. The largest flags obtained measure 10ft. by 3ft., and are 7in. thick. The quarry is equipped with a hand-power crane of 2 tons capacity.

This attempt to prove the value of the slate in this locality, although so far not entirely successful, has not been carried far enough to determine the economic prospects of the locality in which the quarry is situated. (10-3-14.)

REPORT ON RECENT PROSPECTING OPERATIONS IN THE VICINITY OF TUMBY BAY.

LOCALITY—EYRE PENINSULA.

Acting under instructions from the Honorable the Minister of Mines, the writer visited the newly-discovered deposit of magnesite situated in section 6B, hundred of Stokes, a little more than 5 miles distant from the township of Tumby, on March 5th, 1914.

Some notes upon deposits of other non-metallic minerals which are receiving the attention of prospectors in this district are added to the report upon the magnesite deposit.

Geology.—The township of Tumby is built on the plain which forms the coastal fringe to the broken hills lying to the W. and N.W. The sand and loam of the plain is in some places capped with a shallow crust of travertine, and this superficial mantle does not appear to be deep. It is probably of Upper Tertiary to Recent age. The bedrocks upon which this young formation rests are well exposed in the hilly country. The bedrocks are probably of Pre-Cambrian age, and bear witness of intense metamorphism. They are ancient sediments profoundly altered by impregnation with igneous material and distorted by earth movements. Mica schists merging into gneisses, pegmatite, and the alteration products from the metamorphism of magnesian limestones are rock types represented. The structure is exceedingly complex, and can only be determined by detailed mapping. The district with which this report is concerned shows a notable degree of mineralisation and a variety of mineral deposits. Iron ore (for fluxing purposes) and copper ore have been mined—the latter on an extensive scale—although at the time of the writer's visit little work was in progress. Magnesite has been recently discovered in workable quantities. A kaolin deposit is now being opened up. Some asbestos has also been found in the same district, and a deposit of talc has been worked.

It is not certain whether all the mineral deposits mentioned possess some genetic interrelationship, but indications exist which point towards a general connection between the processes which have led to the concentration of copper, iron, talc, magnesite, and asbestos. The kaolin may possibly be the result of the action of weathering agencies upon felspathic rocks such as pegmatite, but the amount of work hitherto carried out is insufficient to afford exposures which might support this hypothesis.

THE MINERAL DEPOSITS.

A.—MAGNESITE.

The principal occurrence which is now being opened up is situated in the S.E. corner of the hundred of Stokes, within section 6B. Two mineral leases, Nos. 2178 and 2179, of 40 acres each have been taken up, and enclose the crown of a long low ridge, the slopes of which are entirely covered with soil which has been under cultivation.

Magnesite is the name given to the mineral composed of the carbonate of magnesium. When pure, magnesite contains 47.6 per cent. of magnesia and 52.4 per cent. of carbon dioxide. The magnesite at the locality with which this report is concerned occurs for the most part in dense fine-grained aggregates which exhibit a conchoidal fracture. The color of the freshly broken surfaces is snow white.

Weathered surfaces are for the most part rough and irregular, being either furrowed by channels or corroded in such a manner that small jagged points stand out in prominent relief. The trenches that have been cut across the deposit also show a nodular or pisolitic variety which outwardly resembles the nodular concretionary travertine that is widely distributed throughout South Australia.

The occurrence of the white specimens of weathered magnesite scattered over the surface of the deposit attracted attention, and a small specimen of the dense porcelain-like material was forwarded to the School of Mines for determination. An incomplete analysis of this specimen was made by Mr. W. S. Chapman, with the following results:—

Water	0.64 per cent.
Magnesium carbonate	99.38 “
Insoluble matter	0.12 “
Lime	Nil
Ferric oxide	Nil
Alumina	Nil
	<hr/> 100.14 <hr/>

The exceptional purity of this specimen led to the idea of exploiting the deposit and preliminary prospecting operations have been begun.

Mode of Occurrence.—The magnesite deposit, as far as can now be ascertained, has not been formed in the manner in which many magnesite deposits have originated, viz., from the alteration of serpentinous rocks by waters containing carbon dioxide. No serpentine has been recognised in the vicinity of the deposits with which this report is concerned; and, in fact, there are no exposures which can afford evidence of the nature of the rock within which the deposit is situated.

The magnesite occurs in veins or greatly elongated lenses which appear to be vertical and to have a general bearing of N. 30° E. A large number of these veins occur irregularly spaced along a zone over 20 chains in length and 1½ chains in width. The maximum thickness of the veins is between 4ft. and 5ft., and a few of them appear to extend continuously for a length of 40ft. At a few points there are outcrops of what seem to be short cross veins connecting those which extend with the length of the deposit.

Closely associated with the magnesite are veinlike aggregates of quartz, hæmatite, and some impure siliceous replacement product. These aggregates are in some places revealed only in the trenches, while in other places they form prominent outcrops.

The country rock on the W. side of the carbonated zone at its S. extremity is mica schist, and carries veins of bluish and white quartz.

The magnesite has probably been formed by the replacement of some magnesium-bearing rock, possibly a magnesian limestone, the replacement having perhaps been effected by emanations from the acid igneous magma which has produced the gneisses and pegmatite dykes of the country immediately to the S.E. Some measure of support is given to this hypothesis by the occurrence of concretionary masses of magnesite on the surface of an outcrop of impure limestone at the talc mine, which is described in a later portion of this report.

Workings.—The work that had been done at the time of the writer's visit consisted only of the cutting of three parallel trenches in the N.E. corner of mineral lease 2178. The bearing of these trenches is N. 60° W.

The most N. trench (No. 1) is situated ¾ chain distant from the N. boundary of mineral lease 2178 and 2 chains from the E. boundary. The trench is 40ft. in length, and has a maximum depth of 5ft. The magnesite cut in this trench shows some superficial stains of iron oxide, and hæmatite occurs in veins parallel with those containing the magnesite.

The central trench (No. 2) is 60ft. in length and attains a depth of 5ft. 6in. at the deepest part. It is situated 1 chain to the S.W. of No. 1 trench. Specular hæmatite is very closely associated with the magnesite in this place also.

The material excavated from both these trenches shows a fair amount of magnesite.

The third trench (No. 3) is a little less than a chain to the S.W. of the central one, and affords an exposure 45ft. in length with a maximum depth of 4ft. 6in. The cleanest magnesite showing in this trench is that exposed at the ends. The vein matter in the central part of the trench contains a notable proportion of iron.

Samples were taken by the writer from the magnesite veins in each of the three trenches, and the analyses tabulated below were made on these samples by Mr. W. S. Chapman, Departmental Analyst. The samples represent, in the writer's opinion, the average grade of magnesite to be obtained by carefully hand-picking the material broken in mining.

	No. 1 Trench.	No. 2 Trench.	No. 3 Trench.
Water at 100° C.	0.30	0.16	0.26
Water above 100° C.	0.94	0.20	0.34
Silica	5.56	1.00	5.12
Alumina	2.03	0.57	2.13
Ferric oxide	0.96	0.20	0.46
Ferrous oxide.....	0.14	0.20	0.19
Lime	1.08	0.24	0.32
Magnesia.....	41.83	46.23	43.01
Carbon dioxide	46.86	50.99	47.46
Sodium chloride	0.28	0.11	0.18
	99.98	99.90	99.47

It will be noted that the proportions of the impurities present in the magnesite are variable. It may be possible to sort out the more impure portions and reject them, but it does not seem possible to raise the grade materially at the present time while working the deposit. Close sampling may serve to guide the work of sorting ; but, in the opinion of the writer, further sampling should not be attempted until deeper and more extensive excavations are made. At present much of the material exposed in the trenches is certainly not *in situ*.

Nevertheless, there is no doubt in the mind of the writer but that a fair quantity of very pure magnesite can be obtained from the deposit by carefully selecting only the clean massive mineral from various points along the outcrops of the veins.

Commercial Application of Magnesite.—The uses to which magnesite are put are several, but some restrictions in respect to quality are made for certain purposes. Thus, while carefully selected mineral from the deposit under consideration may be of universal application, the small proportion of lime shown in the sample from No. 1 trench is sufficient to indicate the necessity for systematic sampling and analysis if an attempt is made to use the mineral for the manufacture of oxychloride cement. Many of the products to be derived from magnesite have a market in Australia at the present time, and very little magnesite has hitherto been mined in Australia.

Magnesite is preferred to calcium carbonate for the manufacture of carbonic acid gas (carbon dioxide) for the reasons that it contains a higher proportion of this gas than calcium carbonate. The gas is liberated at a lower temperature and the residue of magnesia is of higher value than lime.

A considerable proportion of the magnesia obtained by calcining magnesite is used in the manufacture of refractory bricks, crucibles and furnace linings, for

which purposes it is eminently suited by reason of its high fusion point and its resistance to corrosion by molten metals. Thus it is used for lining copper converters in Australia at the present time, and it is probable that a greater demand for this purpose will arise.

A strong cement may be used for mixing the oxide and chloride of magnesium in the presence of water. This cement is used, when added to sand or sawdust, to make a tough resilient paving or flooring material. It is important that the ingredients used for this purpose should be free from lime in order that a durable product may result. Experiments recently made with magnesia prepared from the magnesite deposit under consideration have shown the suitability of the sample tested for one of these preparations; and it is proposed to mine the mineral as a source of the magnesia for which a demand already exists in this State for the manufacture of the so-called "Fama" flooring.

Magnesite is a mineral from which Epsom salts (hydrated sulphate of magnesium) may be prepared, and it is possible that the local manufacture of these salts may be effected in successful competition with the imported article at ruling prices.

Other uses to which magnesite is applied are in glass manufacture, in paper-making, in giving a finish to calico and white cloth, and in the preparation of lagging for boilers and pipes.

Market Value.—Recent statistics having reference to the value of magnesite imported into the United States, and produced in that country, assign to the crude mineral a value of about 10 dollars per ton of 2,000lbs. The calcined and powdered product is estimated to be worth three times as much at New York.

Magnesite has been mined in Victoria and New South Wales on a small scale. The productive locality in Victoria is Heathcote, whence 166 tons were obtained during 1911 and 211 tons during 1912, valued at £3 per ton. The Fifield deposits in New South Wales produced 150 tons in 1911 valued at £225, and in 1912 some 5,700 tons of stone of unrecorded value were raised but not treated.

The locally-produced magnesite, and any magnesia that may be manufactured from it, must compete against the imported materials from Styria and Greece, the value of which is quoted above from American import statistics. Since it should be possible to mine and deliver the crude magnesite at Port Adelaide for not more than £1 5s. per ton, it is reasonable to believe that the working of the deposit near Tumby Bay has a fair prospect of success, provided always that the demand for the magnesite is constant, and that the quality of the mineral when shipped in bulk compares satisfactorily with the imported material.

Conclusion and Recommendations.—While it may be confidently asserted that some hundreds of tons of magnesite can be readily won from the upper portion of the veins outcropping along the crown of the ridge in which the deposit occurs, no larger estimate of tonnage can be framed with any pretence to accuracy.

The size of the veins in depth cannot be confidently foretold at the present time, and it is essential that the first work to be carried out should have for its object the proving of the size and quality of some of the principal veins to a depth of not less than 25ft. The writer would recommend the deepening of the No. 1 or the No. 2 trench and the excavation of a deep trench along one of the best-defined vein outcrops, such as that situated immediately to the N. of No. 1 trench. The excavation on the body of the magnesite would provide material from which a bulk sample could be obtained, and the broken stone would be available for immediate shipment. The quality of the magnesite now accessible is sufficiently good to justify the expenditure of sufficient capital to expose the veins in depth. In the opinion of the writer this preliminary work should be carried out before any scheme of exploitation is definitely formulated.

B.—KAOLIN.

Within the boundaries of section 45 in the extreme S.W. corner of the hundred of Yaranyacka are some small exposures of kaolin. A few shallow excavations had been made at the time of the writer's visit, and the outcrops of kaolin, which are not continuous, had been traced into section 6B of the hundred of Stokes. The kaolin occurs in pockets in a highly altered rock, which appears to have been originally a sediment. It seems probable that the kaolin results from the superficial alteration of veins or dykes of felspathic pegmatites, or felspathised schists. A few specimens of the kaolin carry quartz which may have been in pegmatitic inter-growth with the felspar. Some of the fragments of country rock, exposed by ploughing in the vicinity of the kaolin pockets, consist of dense quartzite, and there is one prominent outcrop of quartzose lode-matter carrying both hæmatite and limonite.

A sample of the kaolin was taken at the site of the principal exposure, the analysis of which was made by Mr. W. S. Chapman, with the following results :—

Water at 100° C	0.85
Water above 100° C	10.15
Silica	56.28
Alumina	29.22
Ferric oxide	1.60
Lime	0.38
Magnesia	0.44
Soda	0.30
Potash	0.61
Carbon dioxide.....	0.66
Chlorine	0.09
	<hr/>
	100.58

A test of the fusibility was also made by Mr. W. S. Chapman, who has reported in the following terms :—"Cones prepared from the sample of kaolin were found to fuse at about the temperature indicated by Seger cone 16, which would be a temperature approximating 1450° C. The kaolin would therefore be classed as non-refractory."

It appears, therefore, that it is not possible to use the kaolin which has thus been tested as a fireclay, and it is very doubtful whether any market can be found for it at the present time.

C.—TALC.

A mineral lease, No. 2078, of 40 acres has been taken up in the W. portion of section 46, hundred of Yaranyacka, 2½ miles to the W. of Lipson, where a deposit of talc has long been known to exist, and is known as the Yaranyacka Talc Mine.

Talc is a hydrated silicate of magnesium which, in the deposit under consideration, is found only in the form of a soft white loosely coherent aggregate of minute flexible foliæ. The mineral feels unctuous or greasy.

The deposit is situated high up on the flank of a ridge which has a general N.E. trend, and the cultivated land to the S.E., in which no outcrops of rock occur, extends to the edge of the workings. The rocks outcropping on the top of the ridge are of sedimentary origin and include impure crystalline limestones. There are weathered masses of magnesite strewn sparsely over the surface where the limestone outcrops, but the only surface indication of the presence of talc is the white dust around the rabbit burrows.

The older workings on the talc penetrated to a depth of about 30ft., and consist of excavations of irregular form, with pillars left standing here and there. These workings were eventually judged to be unsafe, and a shaft was sunk to a depth of 38ft. at a point 30ft. away from the former opening and a little lower down the slope

of the hill. This shaft was sunk in impure talcose material somewhat stained by oxide of iron. A level was driven for a length of 30ft. on a bearing of S. 60° W. to reach a point below the old workings. A chamber was excavated at the end of this drive and a connection was effected with the open workings above. All of these workings are wholly included within the limits of the body of talc, the maximum dimensions of which are known to be not less than 40ft. by 20ft. From this statement it will be seen that the walls of the deposit have not been encountered, and that its real form and relationship to the surrounding country are still unknown.

The principal impurities found in the body of the talc are lenticular masses of quartz which extend for several feet and have a maximum thickness of 9in. The lenses have no regular orientation, but are disposed at all angles through the talc. The deposit consists, but for the presence of quartz lenses, of practically homogeneous minutely foliated talc, with an almost pure white color. A sample was taken by making a cut round the whole face of the talc exposed in the chamber at the end of the drive at the 38ft. level, and the analysis of the sample by Mr. W. S. Chapman afforded the following results:—

Water at 100° C	0.22
Water above 100° C	4.90
Silica	61.26
Alumina	1.76
Ferric oxide	0.33
Ferrous oxide	0.04
Lime	Nil
Magnesia	30.53
Soda	0.17
Potash	0.10
Chlorine	0.30
	<hr/>
	99.61

The only other occurrence of similar material in the vicinity is that revealed by a pit 5ft. deep at a place 300ft. to the N. of the main workings. At this place there exists another mass of talc of unknown dimensions, and with it there is associated a body of impure quartz which makes a prominent outcrop. It has not yet been shown that any connection between the two talc masses exists, and it is unsafe to assume that the talc body will prove continuous between the two outcrops.

The mineral is bagged at the mine and shipped to Adelaide, where it is ground as fine as possible and exported to Queensland and Fiji, whence the present demand for the mineral comes.

The uses for talc such as that which occurs near Lipson are several, the most notable of which are for the manufacture of paper, for lubrication (under the name of French chalk), for toilet powders, for boiler and steam-pipe coverings, for dressing skins and leather, for sizing cotton cloth, as polishing powder, and as an adulterant in various preparations. At the present time there is practically no demand existing in Australia for many of these purposes, and the quantity consumed in the majority of the industries mentioned is not large. The deposit dealt with in this report is able to produce much more of the mineral than can at present find a market in the Australian States.

A certain amount of talc was won from the mine during the earliest stages of prospecting, but no record of these operations is available. The mine was taken over at a later period by the Yaranyaacka Syndicate, which has raised a total of 275 tons, the value of which is estimated at about £1,000. Of this total some 50 tons were shipped during 1913.

The value of the ground talc produced in the United States is estimated to vary from 5 dollars to 13 dollars per ton of 2,000lbs., according to quality. The finer grades are obtained from France and Italy, the prices paid for which in America during 1912 ranged from 13 dollars to 25 dollars per ton, the best French averaging about 18 dollars, and the Italian about 25 dollars per ton.

In conclusion it may be stated that a considerably greater demand for the mineral could be easily satisfied by the body of talc already known to exist. Should a greater demand arise an effort should be made to ascertain, by systematically arranged drives and crosscuts, what the size of the main ore body is, and whether a connection exists between the main mass that has been worked and the talc exposed in the N. excavation.

At the present time the owners of the property are faced mainly with the problems concerned with the raising of the talc as cheaply as is consistent with safety. In the latter connection it should be borne in mind that talc is, by reason of its very nature, a somewhat difficult mineral to handle. Slippery heads are common in the mass of the material, and the ground now being worked at the lowest level should be very carefully watched and supported at close intervals if the least signs of movement are detected. (27-3-14.)

THE RADIUM EXTRACTION COMPANY'S MINE AT MOUNT PAINTER.

LOCALITY—NORTH.

The following supplementary geological report on the Radium Extraction Company's mine at Mount Painter has been prepared in accordance with instructions received from the Honorable the Minister of Mines, an inspection of the workings having been made during the period May 11th to 16th, 1914.

The mine was previously visited by the writer in November, 1912, and a report on the observations made during that visit has been published in Review No. 17 of Mining Operations in the State of South Australia.

Since that examination of the mine was made a considerable amount of additional work has been done, and it is now possible to give a much more accurate description of the mode of occurrence of the ore in the principal workings than was formerly possible.

The main objective of recent operations has been the development of the mine in the vicinity of the shaft at No. 6 workings at the site of the richest shoot of ore yet discovered in the district. During the progress of this work certain other prospecting schemes presented themselves, and operations were consequently extended. Attempts have also been made to locate other bodies of payable ore by carrying out prospecting operations at No. 7 and No. 8 workings.

The data now available with regard to the occurrence of the radium-uranium minerals at No. 6 workings do not appear to be of application beyond the limits of those workings, for the conditions which seem to govern the concentration of radio-active minerals at this place were not observed by the writer to recur at any other points in the district. The workings known as No. 3, No. 4, and No. 5 respectively were revisited with the object of ascertaining whether any of the information recently acquired in opening up the No. 6 deposit could be applied to advantage at these places, but no such application appears possible.

The Occurrence of Radio-Active Ore.—It was pointed out by the writer in his previous report that there exists at the No. 6 deposit a strong ferruginous lode, the trend of which is meridional. The work recently performed on this lode shows that it possesses certain peculiar features. Trenches have been cut across it at various points and two tunnels have been driven in it. These operations have proved clearly that the hard and dense manganiferous iron ore which makes so bold an outcrop constitutes in reality little more than a superficial skin to the main body of the deposit. Through the mass there are distributed irregularly shaped bodies of dense hæmatite and numerous small veins of black manganiferous iron-



Radium Ridge, Mount Painter, from No. 6 Workings.



View of Mount Painter from the Vicinity of Mount Pitts.

stone. The greater part, however, of this meridional deposit consists of soft and friable kaolin which is stained to a deep reddish color by pulverulent hæmatite. In addition there are present subangular blocks of gneiss and pegmatite, which have suffered silification, and a few segregations of quartz. The composition of this lode is such as to suggest formation by the almost complete replacement of a zone of variable width by the agency of solutions which have introduced both iron and silica. The radio-active mineral torbernite is sparingly distributed through the formation, and is most noticeable where streaks or patches of psilomelane or pyrolusite occur.

The composition and character of this main lode remains sensibly constant throughout the depth over which exposures have been made. The material visible in the trenches which penetrate the black superficial skin is identical with that which is exposed at the 100ft. level in the No. 6 workings.

The structure of the meridional lode has been partly determined by mining operations, and it has been shown that the width of the lode is much smaller underground than at the outcrop. The restriction of the width is due mainly to the marked E. dip of the W. wall, for the E. wall is more nearly vertical except near the fault zone, to which reference is made below, where the dip is to the W. The S. portion of this meridional lode is bounded by almost vertical walls, as far as may be judged from the outcrop. A tunnel driven along the course of the lode affords the only subterranean exposure. The wall rocks on each side of the lode have been noticeably altered by impregnation with silica for a distance of a few feet from the outer edge of the ferruginous lode matter. The surfaces of these walls of the lode appear, when the lode matter is stripped from them, rough and irregular as if they have suffered corrosion.

There are traces of movement—shown by slickensided faces—at several points in the main ore body, but no appreciable displacement has resulted in the majority of cases. The irregularities in the form and profiles of the deposit appear to be governed almost entirely by the original form of the lode and the modifications caused by weathering. The trenches that have been cut at various points confirm this statement.

There is, however, one place at which the continuity of the lode has been interrupted by a group of faults which has produced a W. displacement of the S. part of the ore body. In this fault-zone the highest-grade ore yet discovered in the district has been found.

The No. 6 shaft was sunk in this fault-zone to a depth of almost 50ft., but the part of the shaft below that level was sunk in the footwall of the fault-zone, which has an E.-W. strike and a dip to the S. The group of faults embraces a zone some 30ft. in width at the surface, but the component fracture planes unite above the 100ft. level, where the track of the fault is relatively narrow. Exploratory drives in a S. direction show that no defined veins exist to the S. of the fault-zone in the plane which has been prospected. This plane is an almost meridional one passing through the shaft. Beyond the track of the fault torbernite is to be seen in the form of disseminated scales only in the existing workings. The horizontal displacement of the S. part of the main lode amounts to between 30ft. and 40ft.

The best ore yet discovered in the field occurred in the form of narrow veins, and consisted of both autunite and torbernite. These veinlets were found to expand into stronger veins and lenticular masses as they were followed down, and were almost invariably associated with manganiferous ironstone. Autunite was found only in these veins close to the No. 6 shaft, and has not yet been seen at all below the 50ft. level. The shoot of good ore adjacent to the shaft proved to be between 15ft. and 20ft. in length and to extend downwards to a depth of 40ft. from the surface. In this shoot the ore was soft and friable, and the autunite occurred for the most part in horizontal seams and patches. The whole of this material has been removed. The uranium-bearing ore below this depleted shoot consists of scattered crystals and crystalline aggregates occurring in the ferruginous portions

of the fault-zone. There still remains unstopped a large and irregularly-shaped mass of pegmatite within the fault-zone to the E. of the shaft. The rock itself does not carry any uranium minerals as original constituents, but the joints and crevices traversing the block contain autunite and torbernite.

A little to the E. of the main shoot, and within the limits of the fault-zone, a little ore was obtained by trenching, but the grade decreased rapidly between the surface and a depth of 20ft.

The Workings.—At a vertical depth of 50ft. below the apex of the outcrop a tunnel has been driven in a W. direction for a distance of 100ft. across the main meridional lode. The tunnel is wholly within the lode-stuff, which is very wide at this point. The lode material has the brecciated structure referred to above, and contains as a whole a very small proportion of torbernite—much less than can be regarded as sufficient to pay for working. The torbernite is most noticeable where the lode-stuff is impregnated with black mangiferous iron ore, but the highest assay result from an individual sample taken in the tunnel showed only 0.5 per cent. of uranium oxide. The quantity of ore of this grade is almost negligible. The face of the tunnel affords an exposure of the wall rock on the W. side of the lode. It does not seem advisable to do any more prospecting work at this place at the present time.

Another tunnel has been driven in the meridional lode from a point situated to the S. of the transverse fault-zone. The results obtained from this drive, which has been carried N. for a distance of 50ft. along the course of the lode, confirm those mentioned above as having been obtained in the other tunnel. When the information derived from the two tunnels is considered, the conclusion arrived at is that it will be profitless to further prospect the main meridional lode at shallow levels.

The main shaft at No. 6 workings has not been deepened since the writer's former visit to the mine, but a considerable amount of driving has been done. The main fault has been followed in an E. direction, at depths of 36ft. and 100ft. from the surface, as far as the E. wall of the main meridional lode on the N. side of the fault. The same fault has been followed W. on the 50ft. level in a drive connecting with an adit and on the 100ft. level for a distance of 50ft.

S. drives were put in at the 25ft. level for 42ft., at the 50ft. level for 45ft., and at the 100ft. level for 65ft. These drives show clearly that the fault-zone becomes narrower in depth, that the good ore is restricted to the shattered country, and that the percentage of uranium minerals diminishes towards the S. when the fault-zone is left.

These S. drives are in almost the same plane, and appear to the writer to have sufficiently proved that the ore shoot does not extend in that direction.

The Ore Reserves.—The underground reserves are estimated to consist of 300 tons of ore containing approximately 0.5 per cent. of uranium oxide. This estimate is based on a calculation of the probable tonnage and grade of ore in a large mass of pegmatite which is standing in the mine above the 50ft. level, and which has been exposed on two sides. It will be impossible to tell whether or not this estimate will be realised until stoping operations are well advanced. All depends on the continuity of the ore-bearing crevices and fissures which are seen to traverse the pegmatite where it has been exposed.

In addition to this unbroken ore there are about 700 tons at the surface. This tonnage consists of the residues left after the hand-dressing of the ore from the main ore shoot, and the greater part of it has passed through a screen of $\frac{1}{2}$ in. mesh. The hand-picking of the highest-grade ore resulted in 50 tons of picked ore. The rough ore, caught on the $\frac{1}{2}$ in. screen and rejected during hand-picking, is estimated to contain about 1 per cent. of uranium oxide. The larger proportion of fine ore which passed through the $\frac{1}{2}$ in. screen is known to carry 0.74 per cent. of uranium oxide.

Concentration Tests.—Screening tests were made on a parcel of 10 tons of ore from the 25ft. level with a view to raising the grade of the ore for shipping. No crushing machinery was available, and the test was therefore nothing more than a trial of the effect of screening on the ore as mined. The test showed clearly that screening materially raises the grade of the finer sizes. This result is due to the friable nature of the radio-active minerals. Only the external portions of the fragments of ore contribute autunite and torbernite to the product which passes through the screens during this treatment; but it is possible thus to obtain products of a marketable grade from ore that cannot be disposed of in unconcentrated form.

An attempt was made to obtain a further concentration of the finest screen products on an experimental scale by washing. These tests did not afford satisfactory results owing to the lack of difference between the specific gravity of the uranium-bearing minerals and that of the gangue, and also to the tendency of all constituents of the ore to slime.

Conclusion.—The work that has been done at various points in the field shows clearly that the only marketable ore that has been won occurs in a fault-zone traversing a well-defined ferruginous lode. No parallel occurrence has yet been recognised in the district. There are many occurrences of ferruginous lode-matter which show features of close similarity to the material of which the main meridional lode at No. 6 workings is composed, and which also contain disseminated scales of torbernite. All such occurrences stand in undoubted relationship to one another, but in the case of the No. 6 lode only have conditions favored a relatively high degree of concentration of the radio-active minerals. It appears certain that these determining conditions affected the ferruginous lode at that spot subsequently to the period of ore deposition, and that the concentration has been affected by secondary processes. Unfortunately, no determination of the radium-uranium ratio has been made for the autunite and torbernite. The intimate association of the radio-active minerals with manganiferous iron ore appears to the writer to offer confirmatory evidence as to the secondary origin of the ore shoot.

If this be granted it is logical to seek the origin of the uranium among the primary minerals of the main ferruginous lode at No. 6 workings. No trace of any uraniferous mineral has been found in the meridional lode other than torbernite. Samples were taken from the 100ft. level in order that this matter might be tested. Visible torbernite having been removed from the samples, three slightly different types of lode-matter were assayed separately, with a view to the discovery of any invisible uranium-bearing ore. Two samples, when tested by Mr. W. S. Chapman, Departmental Analyst, showed no uranium oxide at all. The third sample, which consisted mainly of manganiferous ironstone yielded 0.2 per cent. uranium oxide. The analyst, however, remarked on this latter sample—"It gave a strong phosphoric acid reaction, and it is probable that this uranium was present as torbernite in such a fine state as to escape detection in preparing the sample for testing."

It appears, therefore, that from what is yet known with regard to the main meridional lode, the nature of the primary ore below the zone of oxidation is unknown, and that it is impossible to say at what depth primary ore will be found. While it is certainly desirable that the nature of the lode in depth should be ascertained, no assurance can be given that development work with this object in view will, if carried out, prove the existence of lode material possessing commercial value.

It is certainly possible that the main meridional lode may carry a higher proportion of torbernite at lower levels than those now worked; but it must be remembered that the grade would not reach that of payable ore unless existing proportions are increased very many times.

With regard to the principal ore shoot itself the value of the ore has decreased below the 50ft. level to such an extent that the shoot can hardly be said to exist below that level. The small E. shoot discovered by trenching on the surface indicates the possibility of discovering other pockets or lenses of ore within the

limits of the fault-zone. With a view to exploring for ore the writer would suggest short S. crosscuts from the face of the E. drive on the 100ft. level, and from a corresponding point on the 50ft. level. The suggested exploratory crosscuts would test the only portions of the fault-zone which remain unprospected. (3-6-14.)

REPORT ON THE CORE OBTAINED FROM THE PARADISE COAL MINING COMPANY'S PROPERTY, NEAR HIGHBURY.

LOCALITY—NEAR ADELAIDE.

The samples of lignite from the bore recently drilled by the Government boring plant in section 2093, hundred of Yatala, have been examined by me.

The lignite has a dull earthy appearance, and there remain few traces of structure in the vegetable matter of which it is composed. Small ovoid blebs of resin are visible in the lignite when it is closely examined.

The bed penetrated by the bore is of considerable thickness at that place, and is on the whole free from bands of shale. The bore entered the lignite at a depth of 150ft. from the surface and the seam proved to be 43ft. in thickness. One band of shale, 3in. thick, was traversed at a depth of 166ft.

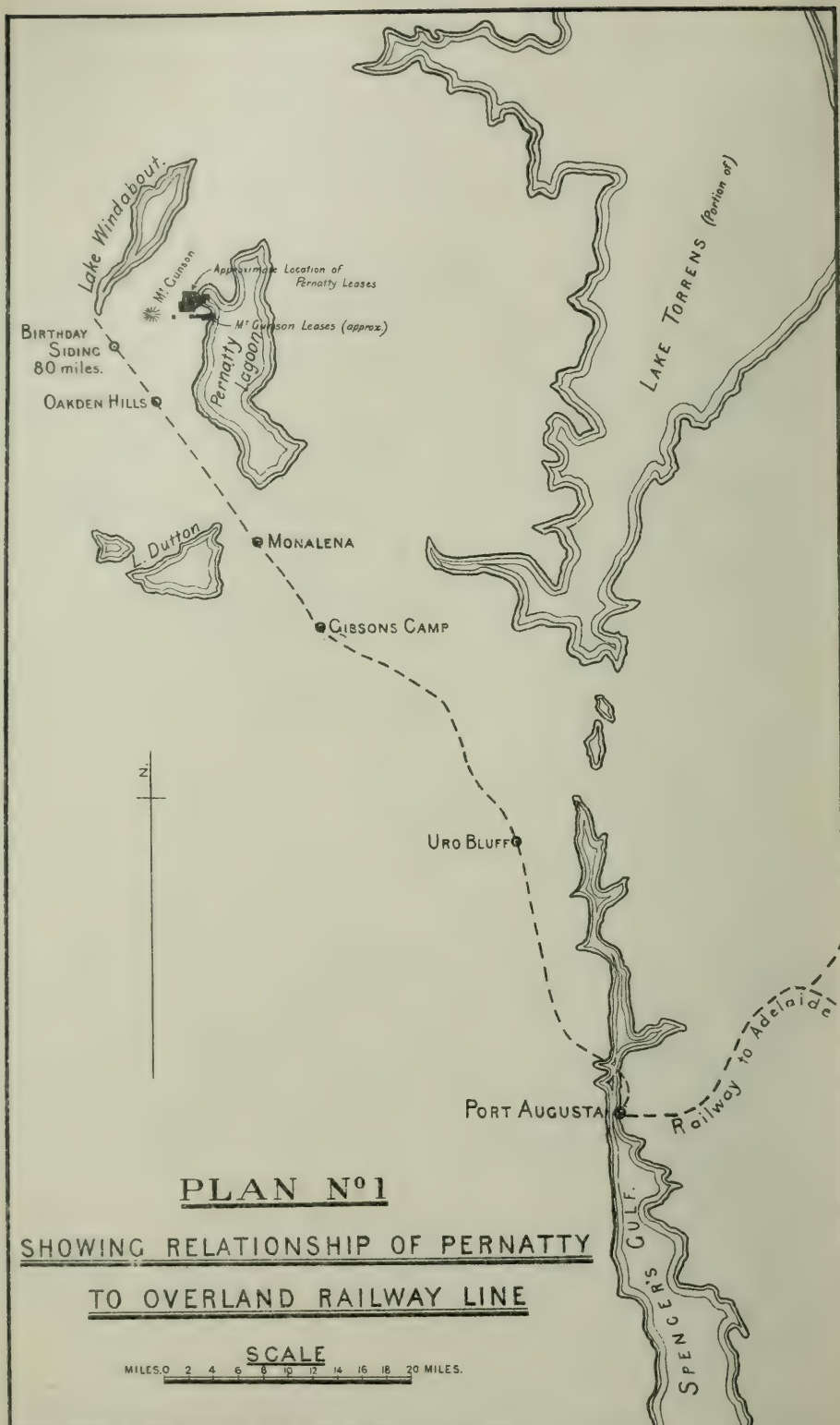
The core obtained is not complete for the whole 43ft., as the lignite proved very friable in places. The samples for analysis were obtained by sawing the core saved into quarters, and comprised the whole quarter section of the core between the depths stated. It was found possible to differentiate the core obtained into four samples only, and these were analysed separately. The second sample, representing the lignite between depths of 156ft. and 176ft. from the surface, did not contain any part of the 3in. band of shale referred to above. The fourth sample represents the lowest 6in. of the seam.

The results of the analyses made by Mr. W. S. Chapman of these samples immediately after they were obtained are as follow:—

	No. 1. 150-156ft.	No. 2. 156-176ft.	No. 3. 176-186ft.	No. 4. 192ft. 6in. to 193ft.
Water at 100° C.....	37.55	47.67	49.46	43.26
Volatile matters	26.95	30.88	31.97	40.06
Fixed carbon (non-caking)	13.45	13.80	8.25	1.40
Ash	22.05	7.65	10.32	15.28
	100.00	100.00	100.00	100.00
Color of ash	Light brown	Brown	Brown	Grey

The samples were subsequently air-dried and the moisture determined at 105° C. instead of at 100° C. as in the analyses reported above. Mr. W. S. Chapman, Analyst to the Department of Mines, has furnished the following results of these further tests:—

	No. 1. 150-156ft.	No. 2. 156-176ft.	No. 3. 176-186ft.	No. 4. 192ft. 6in. to 193ft.
Moisture at 105° C.....	14.70	17.10	16.71	15.35
Volatile matters	36.81	48.92	52.69	59.76
Fixed carbon (non-caking)	18.37	21.86	13.59	2.09
Ash	30.12	12.12	17.01	22.80
	100.00	100.00	100.00	100.00
Sulphur	2.52	2.24	2.70	2.52



An ultimate analysis of No. 2 sample was made by Mr. W. S. Chapman, with the following results :—

Moisture at 105° C.....	17·10
Hydrogen	3·74
Carbon	48·28
Nitrogen	·30
Oxygen	16·22
Sulphur	2·24
Ash	12·12
	<hr/>
	<u>100·00</u>

The calculated calorific value is—

4,547 calories per kilogram ; or

8,184 British thermal units per pound.

It cannot be said that the lignite represented by No. 2 sample, which is the best of the four, compares favorably with other Australian lignites, for the best of which it is still difficult to find a market.

The bore at the Paradise Coal Mining Company's property was continued beyond the bottom of the seam of lignite, and greenish slate bedrock was entered at a depth of 300ft. from the surface.

The results obtained, unfortunately, indicate that the lignite traversed by this bore has no commercial value at the present time. (17-7-1914.)

REPORT ON COPPER DEPOSITS OF PERNATTY COPPER SYNDICATE.

BY

W. E. Wainwright, Manager Broken Hill South Silver Mining Company.

LOCATION.

The copper deposits under review are situated on the Pernatty Lagoon, near Mount Gunson, and about 90 miles N.W. of Port Augusta, in South Australia.

The Port Augusta to Kalgoorlie railway line, now under construction, will pass about 9 miles from the property.

The leases held by the syndicate occupy a position on and about the shores of an arm at the N.W. end of the Pernatty Lagoon—a distance of about $1\frac{1}{2}$ miles N. of the Mount Gunson Mine.

Plan No. 1 indicates the locality, its relation to Port Augusta, and the overland railway.

AREA AND TITLE.

The area held comprises approximately 1,240 acres, in 40-acre leases, which have been recently surveyed—though I understand that the actual lease instruments have not yet been issued.

Plan No. 2 shows the leases held, position of copper deposits, buildings, &c.

CHARACTERISTICS OF DISTRICT.

The surrounding country consists of a comparatively flat tableland, about 100ft. above the level of the lagoon and sloping gradually towards it.

A few small mountains stand out in the distance, and they are all flat-topped.

The rocks of the district are horizontally bedded sandstones, ferruginous quartzites, and occasionally dolomite.

Small watercourses lead down from the tableland to the lagoon, but, except after rain, the water courses are dry.

From a distance the lagoon appears to be a vast sheet of water, but closer inspection reveals a salt-encrusted surface with no visible water, the water level being about 1ft. below the surface of the lagoon.

The ore deposits of the district appear to me as being of sedimentary and secondary origin. So far as they have been developed they appear to exist in distinct channels, and to be nearly horizontal. The most feasible theory to account for their existence is that originally the site of the deposits formed part of a watercourse on the fringe of the lagoon.

The hills in the distance are said to be cupriferous in a small degree, and the copper could have been brought along from this source, and redeposited in the channels on the lagoon fringe as sulphides. Subsequent readjustment of the ground and water levels left some portions of the deposit above water level, permitting their oxidation, as in the case of Mount Gunson, Gunyot, Ramsay, and the Gun—where the copper minerals consist chiefly of atacamite and possibly copper chloride.

Those portions of the deposit remaining below the lake water level remained unoxidised, merging into oxidised ores at and above water level—and which secondary oxidation has probably brought about a further local enrichment.

The Pernatty Lagoon sulphides come under the last head.

THE COPPER DEPOSITS.

So far as is at present known, four different copper deposits occur on the leases held by the Pernatty Copper Syndicate—

- (a) Pernatty Lagoon, sulphides.
- (b) Gunyot, oxidised deposit.
- (c) Ramsay's, oxidised deposit.
- (d) The Gun, partially oxidised deposit.

There is a marked similarity in the general manner of occurrence of the several deposits, and also those of the neighboring Mount Gunson Mine, though each has its individual characteristics.

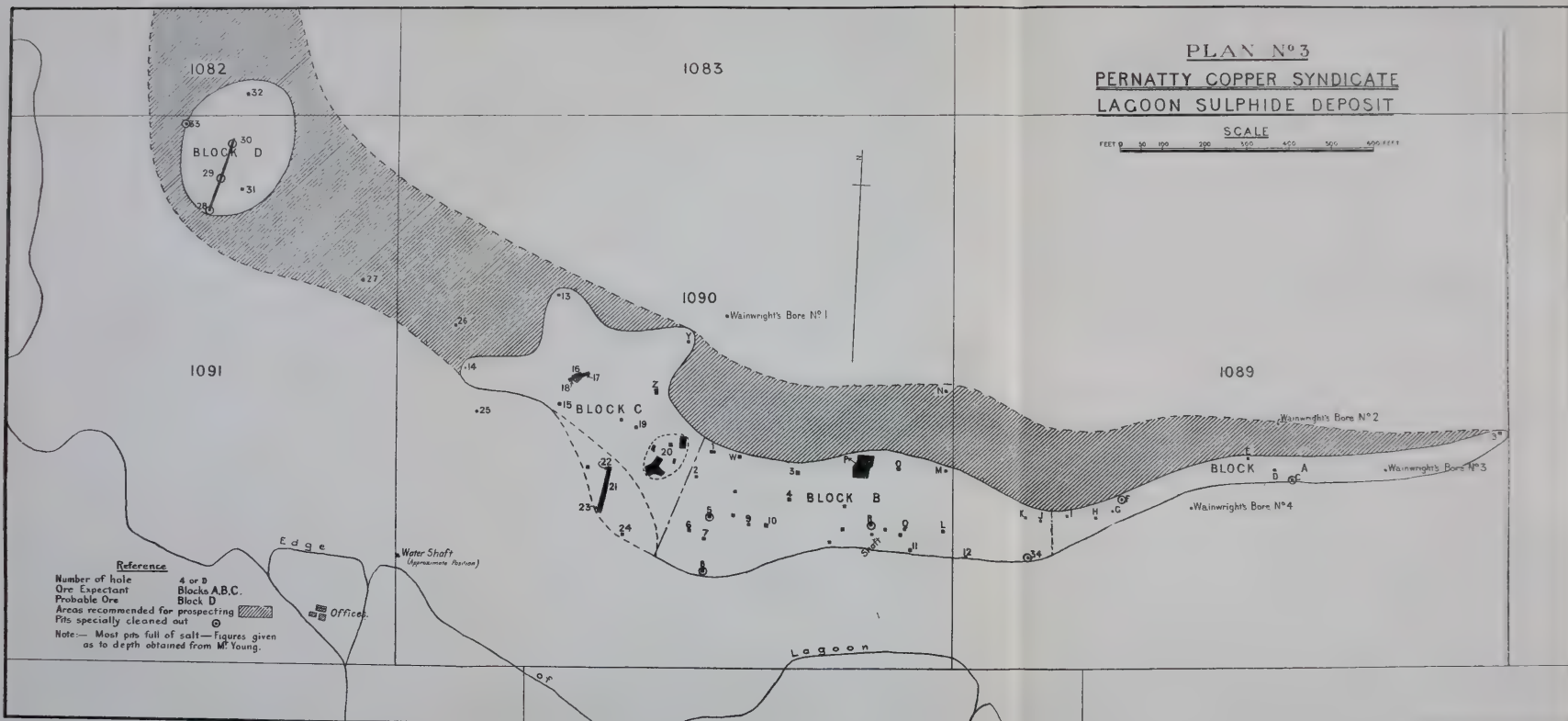
(A) *Pernatty Lagoon Sulphides*.—This deposit is at present the most important of the Pernatty group, and, as shown on Plan No. 3, is situated in sections 1089, 1090, and 1091, occupying a position adjacent to the southern edge of the lagoon—the copper-bearing channel running more or less parallel to the fringe.

The surface of the lake consists of a clay alluvium, varying in thickness from a few inches to about 1ft. on the N. limit of the proved copper-bearing area.

Beneath the alluvium is a soft sandstone, for the most part heavily charged with oxides of iron and manganese, and occasionally carrying small copper values; the average thickness of this bed is 3ft., and it is locally known as the *overburden*. This overburden was sampled in several places, and gave .2 per cent. Cu.

Below the overburden occurs cupriferous sandstone, carrying also iron and manganese, and known locally as *leaching sands*. It is upon this material that most of the work done on the lagoon has been concentrated. The average thickness of the bed is 5ft., carrying Cu. values varying from .3 per cent. to 6.7 per cent.

The copper occurs as atacamite, covellite, bornite, and chalcocite, impregnating the soft sandstone; in some rich patches the sand grains are cemented together in a mass of chalcocite.



REFERENCE TO PLAN No. 3.

BLOCK A.

Hole.	Remarks.	Hole.	Remarks.
B	Depth 10' Overburden .. 2.5' Leaching sand 7.5' Dump seconds 1.8% Cu.	H	Depth 3.5' Dump seconds 2.1% Cu.
C	Depth 3.5' Overburden .. 1.5' Leaching sand 2.0'—1.6% Cu. Bottom Quartzite Dump seconds .6% Cu.	I	Depth 10' Overburden .. 1.5' Leaching sand 8.5' Dump seconds 2% Cu.
D	Overburden .. 1.5' Leaching sand 4.5' Bottom Quartzite Dump seconds 3.8% Cu.	No. 2*	12' deep 9.5'—11.5' Trace
E	Overburden .. 2.0' Leaching sand 5.0' Dump seconds 1.4% Cu.	No. 3*	9' deep 0'—2' Overburden 2'—4.5' Sandstone (cupriferous) 4.5'—9' Sandstone (no values)
F	Depth 3.5' Overburden .. 2.0' Leaching sand 1.5'—5.4% Cu. Bottom Quartzite Dump seconds 2.1% Cu.	No. 4*	8.5' deep (no values)

*Wainwright's Bore.

BLOCK B.

Hole.	Remarks.	Hole.	Remarks.
J	Depth 5' Dump seconds 2.8% Cu.	2	Depth 8.5' Overburden .. 2.5' Leaching sand 6.0'
K	Depth 14' Overburden .. 2' Leaching sand 12' Dump seconds .7% Cu.	3	Depth 13' (no values) Bored 13'—16' (no values)
L	Depth 10' Dump seconds 1.4% Cu. Dump overburden .7% Cu.	4	Depth 8.0' Overburden .. 2.0' Leaching sand 6.0'
N	Depth 8' Traces reported	5	Depth 7.0' Overburden .. 1.0' Leaching sand 3.0'—2.8% Cu. Bottom Quartzite 2.4% Cu.
O	Depth 10' Bored by Dyason— 10'—15' Trace 15'—20' 1% Cu.	6	Dump seconds 1.6% Cu.
P	Reported depth 20'—25' All dumps removed	7	Dump seconds 1.8% Cu.
Q	Depth 10' Overburden .. 1.5' Leaching sand 3.5' Dump seconds 1.8% Cu.	8	Depth 4.0' Overburden .. 2.0' Leaching sand 1.75'—1.6% Cu.
R	Depth 4' Overburden .. 2' Leaching sand 2'—2.4% Cu. Dump seconds 2.1% Cu.	9	Overburden .. 1.0' Leaching sand 3.0'
W	Depth 13.5' Overburden .. 4.5' Leaching sand 9.0'	10	Depth 5'—8'
1	Overburden .. 2.5' Leaching sand 6.0' This hole yielded £900 in two weeks; copper, £110 per ton	11	Depth 2'
		12	Depth 5' Overburden .. 2' Leaching sand 3'
		34	Depth 5' Overburden .. 1' Leaching sand 4'—1.5% Cu. Bottom Quartzite 2.2% Cu.

BLOCK C.

Hole.	Remarks.	Hole.	Remarks.
Y	Depth 18' Overburden .. 6' Leaching sand 12'—7% Cu. (rich firsts 2.2% Cu. on west side of pit not included) Bottom Quartzite 3.6 Cu.	17	Winze from bottom of cut sunk 7' in quartzite. Value 3.4% Cu. Depth below surface of lake 14'
Z	Depth 13.0' Overburden 4.75'—Nil Leaching sand 6.5'—6.7% Cu. (pocket of firsts showing in this pit) Bottom Quartzite 3.7% Cu.	18	Winze from bottom of cut sunk 4' in quartzite. Value 2.1% Cu. Depth below surface of lake 10'
13	Depth 11.0' Bored to 22' by Dyason— 11'—12.5' Trace 12.5'—18.0' 2% Cu. 18'—22' Trace	19	Depth 7' ' Overburden .. 4.5 Leaching sand 2.5'
14	Bored— Overburden .. 0—2' Leaching sand 2'—3½' (cupriferous) 3½'—4½ Sandstone	20	Various pits. 4'—7' and 20' deep Average from dump seconds, several large heaps 1.4% Cu.
15	Depth 8' Overburden .. 2' Leaching sand 6'	21	Trench— Overburden .. 2.0'—6% Cu. Leaching sand 2.0'—6% Cu. Bottom chiefly quartzite 7% Cu. Average depth of trench including clay alluvium 5.7' Average value of trench 63% Cu.
16	Stripping hole Overburden .. 2.95'—3% Cu. Leaching sand 2.83'—8% Cu. Bottom Quartzite 2.9% Cu.	22	Quartzite in bottom 1% Cu.
		23	Quartzite in bottom 5% Cu.
		24	Dump seconds 2 2% Cu.
		25	Bored 0'—6' (no values)
		No. 1*	34' deep (no values) *Wainwright's Bore.

BLOCK D.

Hole.	Remarks.	Hole.	Remarks.
26	Depth 2' Bored 2'—5' Trace	30	Depth 10'—6.2% Cu. Quartzite across bottom
27	Wainwright's Pit No. 2— 7.5' (no values) Bored 7.5'—12.5' (no values)	31	Values reported here— Overburden .. 1.0' Leaching sand 5.0'
28, 29, 30	Trench. Dump sample, small dumps— Overburden .. 7% Cu. Seconds 4.2% Cu.	32	Depth 16' Values reported at 13' Dump seconds 1% Cu.
28	Depth 4' Sample of picked material S.W. corner— 15.2% Cu.	33	Depth 5' Overburden .. 1.5' Quartzite 3.5'—3% Cu.
29	Depth 6'—2.4% Cu.	35	Depth 10' Traces reported

The bed of *leaching sands* is not quite horizontal; it dips slightly to the north and undulates in small areas, making pockets of high-grade sulphides—which have contributed largely to the quantities of 15 per cent. to 20 per cent. Cu. picked market ore sent to the smelter by the discoverer of the deposit (Mr. F. Young).

The copper values in this bed are irregularly distributed, there being barren patches and very rich pockets—as well as areas of average grade.

On being exposed to atmospheric influence the sands rapidly disintegrate and the copper sulphides begin to oxidise, so that copper may be extracted by ordinary leaching with the lagoon water, though the percentage extraction is low.

Underlying the leaching sands is hard red quartzite; on account of the hardness of this material it has never been penetrated sufficiently to ascertain whether it is the basal rock. It was generally believed that the copper values were limited to the sandstones above this quartzite, but in several places where holes have been sunk in it good copper returns have been obtained, and examination discloses the fact that the ore is mainly chalcocite deposited in joint and bedding planes in the quartzite—but not universally impregnating the rock.

The average copper contents of the exposures sampled were 3 per cent. Cu.

The greatest thickness of red quartzite exposed is in the winze at the E. end of the stripping hole—where the depth of sample was 7 ft., assaying 3.4 per cent. Cu.

Returns furnished by the vendor show that 260 tons of picked ore, averaging 16 per cent. Cu., have been sent to the smelters from the lagoon sulphide deposit; he also states that additional ore was sold, but the returns are not available. The above ore was picked from rich pockets, which were located by surface prospecting.

The Lagoon Workings.—The workings on the lagoon deposit consist of a number of pits, excavations, and trenches, most of which have been put in by the vendor in his search for market ore. The pits vary in depth from 1 ft. to 20 ft., and are irregularly spaced over the area of the deposit.

At the time of my visit all the older pits contained crystalline salt up to water-level. Excavations Z, Y, the trench, and the stripping hole were, however, open for inspection. Pits marked with a circle on plan No. 3 were cleaned out at my request and the faces sampled. Pits Nos. 1 and 2 respectively, are new pits, and were sunk under my direction, in addition to which I was enabled—by the courtesy of the Mount Gunson management—to borrow a percussion drill and put down four holes, as shown on the plan.

The above sulphide deposit has been proved to extend over a total length of 2,500 ft. with a width varying from 60 ft. to 300 ft.

(B) *The Gunyot Oxidised Deposit.*—This deposit, situated in section 1102, distant about $\frac{3}{4}$ mile in a S.W. direction from the lagoon, and 70 ft. above it, closely resembles those of the neighboring Mount Gunson Mine in every way. The copper occurs as atacamite, the oxychloride with some cuprous chloride cementing together the siliceous particles of the cupriferous sandstone. The tendency to undulate exhibited by the lagoon sulphide deposit, is seen also in this case.

The overburden, which averages 8 ft. in thickness, is free from copper, and consists of loose rubble, clay, and limestone caliche.

The deposit averages 5½ ft. in thickness, having copper contents which vary from .9 per cent. to 3.9 per cent. Cu., but average 2.3 per cent. Cu.

According to the smelter returns submitted, Mr. Young has marketed 72 tons of dressed material, averaging 11.2 per cent. Cu.

WORKINGS.

Pits and excavations, to the number of 25, have been opened on the oxidised deposit, several of which—including the open cut, No. 3 on plan No. 4—still have ore showing in the bottom. The longer axis of the deposit runs approximately N. and S.

The better values exist at the S. end of the cupriferous area ; the lateral extension is probably limited in the E. and W. directions, but the deposit may be found to extend outside the present proved area in the direction of the longer axis.

The extent of copper deposit proved by the above workings is 350ft. long with an average width of 115ft.

(c) *Ramsay's Oxidised Deposit.*—This deposit, as shown on plan No. 2, is situated in section 1092. Very little can be said of this ore body, as the few excavations which have existed are now filled with drift sand. A small dump near by suggests that the ore occurs as a highly manganiferous ironstone, carrying a small percentage of copper in an oxidised form.

(d) *The Gun—Partially Oxidised Deposit.*—The Gun lease is 1106 on plan No. 2, and is surrounded by those of the Mount Gunson Company. The cupriferous deposit, while resembling those already described in its chief physical characteristics, differs in two points, viz.—

1. The ore is more basic, containing about 15 per cent. of manganese dioxide and 17 per cent. of iron protoxide.

2. The underlying rock is dolomite.

The deposit lies about 12ft. below the surface, and is about 5ft. thick. Mr. Young has done a considerable amount of work on this ore body, his drives extending over a length of 150ft. from the N. boundary of the lease. It was not possible to examine all the workings in this mine, but the ore channel would not appear to have much width—30ft. or 40ft. possibly. A W. crosscut face examined showed gypseous aluminous clay, carrying no copper. The extension of the channel in a S. direction should, however, be well worth prospecting for copper contents.

A deep bore put down by Mr. Currie, 414ft. to the N.—in the Mount Gunson Company's lease—proved 5ft. of ore at a depth of 20ft., carrying .86 per cent. Cu.

The copper occurs as atacamite, with some chalcocite and bornite. Samples taken averaged 1.5 per cent. Cu. Returns submitted showed that 74 tons of dressed ore, averaging 15.6 per cent. Cu., had been sent away. This ore was obtained from pockets occurring on the irregularly eroded surface of the dolomite, having the appearance of gutters.

ORE RESERVES.

The ore reserves are classed as follows :—

1. *Ore Expectant.*—This term covers the quantities estimated to exist on the lagoon sulphide and the Gunyot oxidised deposits. Owing to the patchy nature of the deposits the quantities given cannot be regarded as positively developed, but there is a reasonable assurance that such tonnages exist.

(A) *The Lagoon Sulphide Deposit.*—For purposes of estimation the cupriferous area containing ore expectant has been divided into four blocks, viz., A, B, C, D, the total tonnages and values from each block being combined to form one total of a general average Cu. content, in which an allowance for the rich pockets—containing firsts—has been incorporated on a basis of 5 per cent. of the total tonnage, averaging 15 per cent. Cu. This allowance was based on the proportion of firsts marketed to the total mined, and, while it is the closest estimate obtainable under the circumstances, is only an approximation.

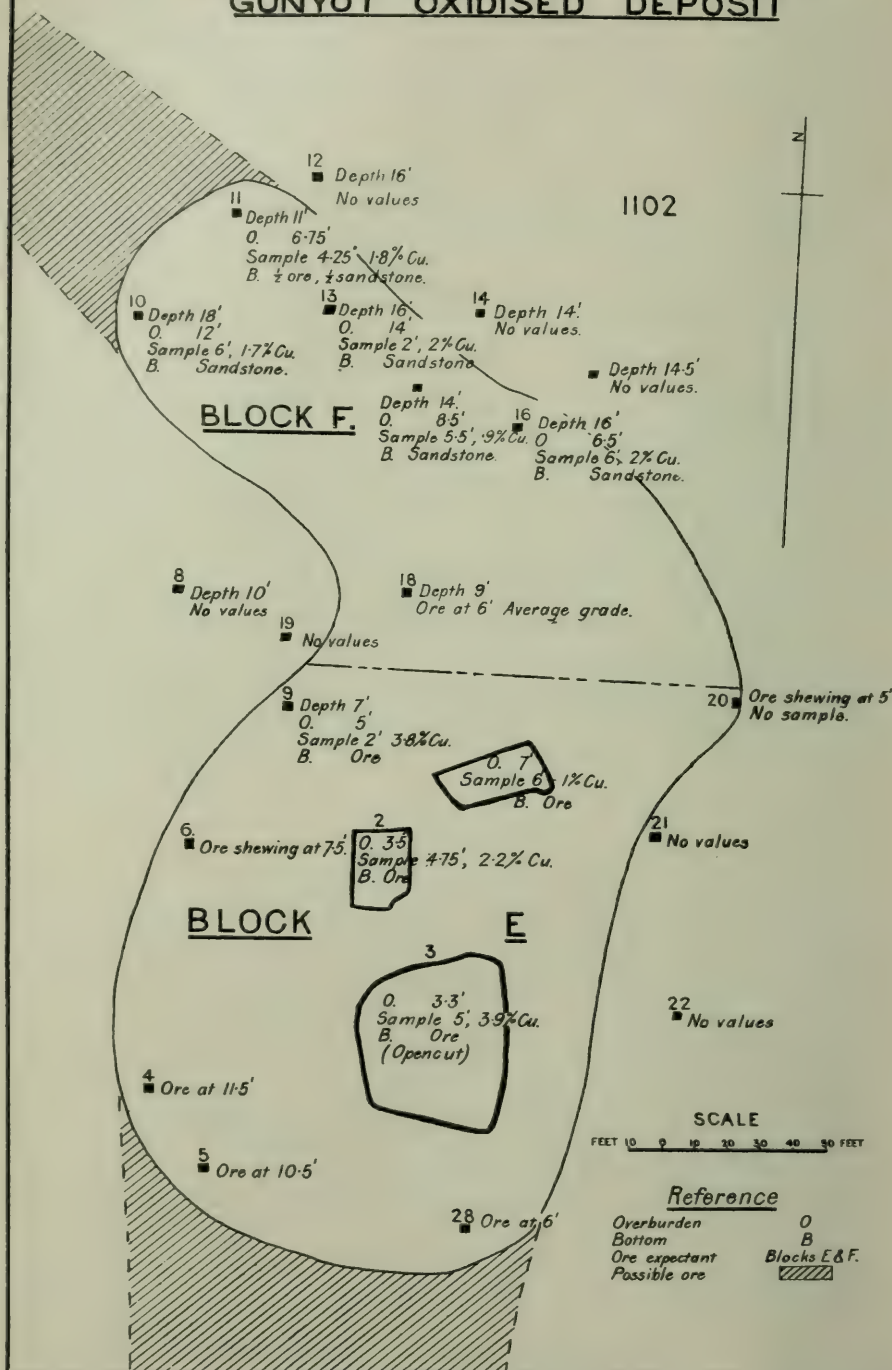
A factor of 14 cub. ft. to the ton is used, and 20 per cent. subtracted from the total, in order to compensate for barren patches and the looseness of the leaching sands.

Block D is treated separately, in order to cover the quantity of hard quartzite opened up in block C by the stripping and holes Z and Y.

— PLAN N^o 4 —

PERNATTY COPPER SYNDICATE

GUNYOT OXIDISED DEPOSIT



The following table shows the position in regard to "ore expectant" on the lagoon:—

Block.	Tons.	Per cent.	Cu.	Remarks.
A	18,750	..	2·5	These figures refer to seconds only; no firsts included
B	82,040	..	2·4	
C	59,820	..	1·7	
D	320	..	3·2	
	<u>160,930</u>	..	<u>2·16</u>	

Material.	Tons Crudes.	Per cent.	Cu.	Remarks.
Lagoon seconds	160,930	..	2·16	Calculated by measurement.
Lagoon firsts	8,046	..	15·00	Calculated on basis of 5 per cent. of total
	<u>168,976</u>	..	<u>2·77</u>	

Less 20 per cent. gives 135,000 tons at 2·77 per cent. Cu., containing 3,739·5 tons of copper.

(B) *The Gungot Oxidised Deposit*.—For convenience in estimating, this deposit has been divided into two blocks, E and F. The factor is 13 cub. ft. to a ton.

The following statement shows the quantity of "ore expectant":—

Block.	Tons Crudes.	Per cent.	Cu.
E	9,915	..	2·6
F	6,545	..	1·9
	<u>16,460</u>	..	<u>2·3</u>

Say, 16,000 tons at 2·3 per cent., containing 368 tons of copper.

Note.—The market ore sent away is equivalent to 350 tons of 2·3 per cent. Cu. Thus we have a final statement of "ore expectant" as under—

Deposit.	Tons Crudes.	Per cent.	Cu.	Tons Cu.
Lagoon sulphides	135,000	..	2·77	3,739·5
Oxidised ore body	16,000	..	2·30	368·0
	<u>151,000</u>	..	<u>2·72</u>	<u>4,107·5</u>

The following is a statement showing that by cutting out the poor zone in block C—adjacent to the trench and shown dotted on plan No. 3—the averages of Cu. contents are increased:—

Deposit.	Tons Crudes.	Per cent.	Cu.
Lagoon sulphides	160,930	..	2·16
Poor zone	9,430	..	·63
	<u>151,500</u>	..	<u>2·25</u>

Material.	Tons Crudes.	Per cent.	Cu.	Remarks.
Lagoon seconds	151,500	..	2·25	Calculated from measurement.
Lagoon firsts	7,575	..	15·00	Calculated on basis of 5 per cent. of total.
	<u>159,075</u>	..	<u>2·86</u>	

Less 20 per cent. gives 127,260 tons at 2.86 per cent. Cu. as the value of the lagoon sulphide deposit.

Deposit.	Tons Crudes.	Per cent. Cu.	Tons Cu.
Lagoon sulphides	127,260	.. 2.86 ..	—
Oxidised ore body	16,000	.. 2.30 ..	—
	<u>143,260</u>	.. <u>2.80</u> ..	<u>4,011.28</u>

The final statement then shows 143,260 tons of "ore expectant," having an average assay value of 2.8 per cent. Cu.

2. *Probable Ore.*—There are two sources on the lagoon from which there is every likelihood of further supplies of ore being obtained, viz., the hard quartzite which underlies the leaching sands, and the western workings known locally as the "Bornite workings."

In regard to the former source, evidence afforded by the cupriferous nature of the bottoms of the various excavations on the lagoon—particularly the stripping hole and holes Z and Y—is of a satisfactory character, and establishes the fact that the deposit has not yet been passed through. No estimate can, however, be made for ore below the bottoms of the pits.

In regard to the W. workings, there is evidence of considerable work having been done; a trench 186ft. long exists, and several pits have been sunk. At the time of my visit all these excavations were filled with salt. I had the trench cleaned out in three places, and in each case the bottom disclosed quartzite—carrying good values for copper, which was in the form of chalcocite.

A pit to the W. of the trench was also cleaned out, and disclosed satisfactory evidence of the existence of ore.

This area is evidently strongly cupriferous, but the information as to quantities available is at present too meagre to justify an estimate.

Future Prospects of the Mine.—The areas colored red on the accompanying plans, Nos. 3 and 4, are considered worth prospecting for the possible extension of the deposits laterally. Both the Ramsay and Gun claims are also well worth prospecting, in addition to which there is some chance of other and entirely new deposits being discovered.

The prospects warrant the inauguration of a systematic boring campaign.

WATER SUPPLY.

The problem of water supply in this district requires very close investigation before any industrial enterprise could be successfully initiated. The rainfall returns for the Oakden Hills station, taken for 31 years, from 1880 to 1912, indicate a very irregular and precarious supply, varying from 2.35in. to 14.93in., the average per year being 6.95in.

The evaporation rate is about 8ft. per year.

Fresh Water.—Fresh water would be required for domestic purposes, watering stock, in a minor degree for cooling power plant (though the motive power best adapted for use would be oil and producer gas engines), and to supplement the lagoon salt water supply for treatment purposes.

There are a number of wells in the district, which supply approximately 1,000galls. per day of comparatively fresh water—suitable for stock-watering purposes. It is possible that suitable water might be obtained by means of artesian bores.

Several small catchments exist around the shores of the lagoon, on the property, and water could be conserved in these by throwing embankments across the creeks, and, while it must not be forgotten that these would form shallow reservoirs of doubtful holding capacity—and the loss by evaporation would be very severe, this policy would have the advantage of keeping flood waters off the lagoon workings.

It is very advisable that several promising catchment areas in the vicinity of Pernatty Lagoon should be examined carefully, from a water conservation point of view. The general country rock consists of horizontally bedded quartzites—and these are of doubtful holding capacity.

Salt Water.—The lagoon contains a fair supply of water, which, being practically saturated with salt, limits its useful qualities.

The following is an analysis of the lagoon water :—

	Grains per Gallon.	Per cent.
Silica	3.0 ..	.02
Fe ₂ O ₃ .Al ₂ O ₃ (bauxite)	6.0 ..	.04
Calcium	115.0 ..	.71
Magnesium	523.0 ..	3.24
Sodium	4,893.0 ..	30.28
Potassium	494.0 ..	3.26
Chlorine	9,472.0 ..	58.62
Sulphuric acid (SO ₄)	647.0 ..	4.01
Carbonic acid (CO ₃)	3.0 ..	.02
Total solids.....	17,716.0 ..	100.0

The probable salts in combination are—

	Grains per Gallon.	Per cent.
Silica	3.0 ..	.02
Bauxite	6.0 ..	.04
Calcium carbonate	5.0 ..	.03
Calcium chloride	314.0 ..	1.94
Sodium chloride	12,445.0 ..	77.02
Potassium chloride	943.0 ..	5.82
Magnesium chloride	1,405.0 ..	8.75
Magnesium sulphate	815.0 ..	5.04
Excess chlorine	220.0 ..	1.34

The water carries 25 per cent. of salt, and the specific gravity is 1.151. Owing to the water being nearly saturated with salt, the salt is readily precipitated on foreign bodies thrown in the water, and to use such water for condensing is practically hopeless.

It is evident, also, that while the water might be used for treatment purposes—under exceptionally favorable conditions—it is so close to saturation point as to necessitate a supplementary supply of fresh water.

The Mount Gunson mine has sunk several shafts in the lagoon bed, and pumped from them continuously to ascertain the quality and quantity of water to be obtained. From a quality point of view continuous pumping does not reduce the salt contents, for a sample taken from this source carried 17,300 grains per gallon, as compared with 17,716 grains per gallon from a stagnant shaft at Pernatty.

The shafts make varying quantities of water, the total obtained by continuous pumping from three shafts being 25,000galls. per day—and this water contains no copper.

It is evident, from the change in the appearance of the surface alluvium around the area in which the shafts were sunk, that continuous pumping is slowly draining the area—so that a number of shafts would be required to furnish an adequate supply of lagoon water.

In the case of the Pernatty Lake deposit, the open cut in the lake bed—left as the ore is mined—should furnish a sufficient drainage area for lagoon water supply.

FUEL.

Myall and mulga grow fairly plentifully on the surrounding country. Myall is a particularly good burning material, and would be suitable for roasting.

TRANSPORT.

The Transcontinental Railway now passes within 9 miles of the property. Basing freight charges on the Silverton Tramway Company's rates, railway charges from Port Augusta to Birthday Siding (80 miles) should run out as below—

	Per Ton.
Coal and ore	5s.
Timber	11s.
Scrap iron	7s.
Sulphuric acid	19s.
General goods, pipes, rails, oil, &c.	35s.

Being a Government line, cheaper freight rates than the above may be secured.

A branch line has been surveyed into Mount Gunson Mine. As to whether or not it will be constructed, I am unable to express an opinion.

The road from the property into the siding presents no difficulties to transit by camel pack, and an expenditure of a comparatively small amount of money would put it in good order for use by motor lorries.

The cost per ton by camels should not exceed 1s. per ton per mile.

Motor lorry transit should not be greater than 1s. per ton per mile.

MINING.

The nature of the deposits is such that they could be very cheaply mined by the open-cut method. The ore should be extracted to its full depth, the overburden being stripped off first and dumped behind as the cut advances.

The water could easily be held in check by pumping from shafts sunk in advance of the working faces and sumps in the bottoms of the cuts.

The material could be conveyed to the mill site mechanically—by aerial trams—from both deposits. The cost of the sorted material, delivered at the treatment plant, should not be more than 4s. 6d. per ton of crudes—on a large scale.

TREATMENT.

The best form of treatment can only be determined by extensive experiment on bulk quantities of ore of representative quality; the experimental plant should be located on the mine.

The oxidised ore lends itself readily to lixiviation by sulphuric acid, but the sulphides would have to undergo a roast. The fact that plentiful supplies of salt exist suggests that the possibilities of wet treatment by a slightly acidulated solution, preceded by a chloridising roast, should be thoroughly investigated. Both classes of ore could be treated in the same plant.

No estimate of cost of plant, or cost of treatment, can be given until the method of treatment is determined.

SUMMARY.

Four copper deposits have been proved to exist on the property—

- (A) *Pernatty Lagoon Sulphides*.—Containing 135,000 tons of 2.77 per cent. Cu., reasonably expectant.
- (B) *Gungot Oxidised Deposit*.—Carrying 16,000 tons of 2.3 per cent. Cu., reasonably expectant.
- (C) *Ramsay's Oxidised Deposit*.—A copper-bearing deposit has been disclosed in a trench, but no systematic development has been carried out.
- (D) *The Gun—Partially Oxidised Deposit*.—Rich deposits in gutters on eroded dolomite, about 15ft. below the surface, have been worked for a length of about 150ft. No measurable quantity of ore developed.



Pernatty Lagoon Workings.

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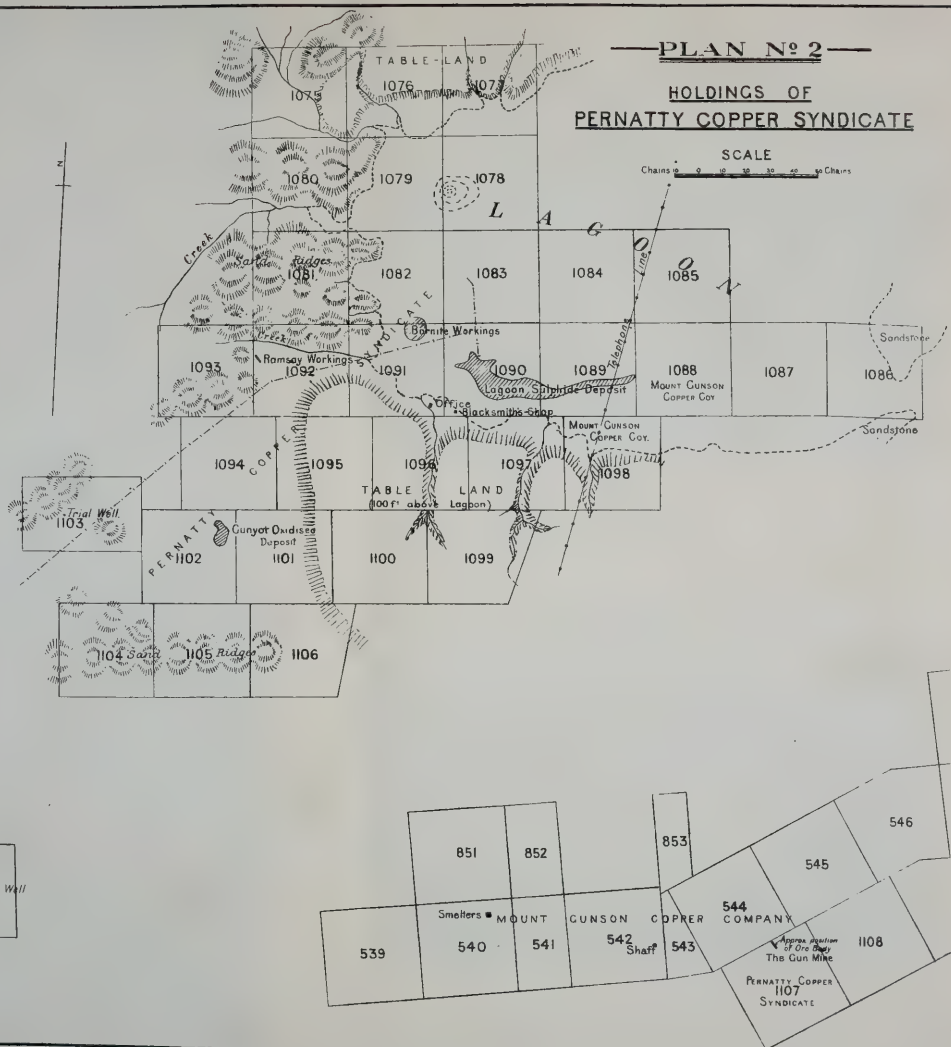
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PLAN No 2

HOLDINGS OF PERNATTY COPPER SYNDICATE

SCALE

Chains 0 10 20 30 40 50 60 70 80 90 100



All the above deposits require further development, which is certain to result in augmentation of the ore reserves—and perhaps in increased grade of ore.

There is room for the discovery of other copper deposits on the leases held by the Pernatty Syndicate.

The character of development recommended is percussion drilling, which is expeditious, inexpensive, and affords fairly reliable information as to copper values. Values so ascertained are likely to be slightly below the actual value of the ore.

Where favorable results were obtained from the drilling, pits could be sunk to check results. Drilling would obviate sinking developmental pits in barren ground.

In order that reliable information may be obtained from the percussion drilling, the work should be superintended by a technical man—able to carry out the assaying. The borings can readily be “salted,” and, as nothing but a fresh bore or shaft can check the results, it is essential that this portion of the work be carried out under careful supervision.

The deposits must be considered as a low-grade leaching proposition, and to be profitably treated will need to be worked on a large scale, consequently every effort should be made to develop sufficient tonnage of ore to justify the erection of a fair-sized plant.

Mining cost is estimated at 4s. 6d. per ton of ore, delivered to the treatment plant. Method of treatment needs careful investigation before definite figures of cost can be given.

Water conservation is a very important factor, and considerable attention will need to be given to obtaining an assured water supply. (11-6-14.)

TREATMENT REPORT ON THE PERNATTY ORE.

By F. M. MURDOCH, late Chief Chemist, Mount Elliott Copper Mine Queensland.

In the trial to which the Pernatty ore has been submitted at Ballarat no difficulty in treatment by chloridising roasting has been met with, a satisfactory economy when operated on a large scale has been indicated, and the losses have been small.

For the purpose of the trial the various classes of ore were mixed in approximately the proportions in which they occur in the mine, viz. :—

Leaching sand	20 parts
Gunyot	2 “
Rich sulphide	1 “

to this mixture was added—

(1) Salt, 3 per cent. ; pyrites, 3 per cent.

and in a later trial—

(2) Salt, 4 per cent. ; pyrites, 4 per cent.

The mixture (1) gave the most satisfactory results, probably owing to conditions of temperature rather than proportions of charge. The copper contents of this charge were 3·7 per cent. Half the length of an Edwards tilting simplex furnace was used for the roast, the distance traversed by the ore being 26ft., and the fall in that distance 15in.

DEGREE OF FINENESS.

Approximately two-thirds of the ore was not crushed but screened through a one-eighth screen, the remainder being crushed to about the same grade. This appeared to be a quite satisfactory size, and, taking into account the moisture, could be best obtained by a disintegrator. Any expensive type of crushing machinery could not be recommended on account of the corrosive action of the moist ore on iron and steel.

SOLUBILITY OF COPPER.

On the first charge (3 per cent. salt, 3 per cent. pyrites) the water soluble copper obtained was 93 per cent. of the total.

This does not represent the total recovery of copper, as the remaining 7 per cent. should be dissolved in the acids (HCl , H_2SO_4 , H_2SO_3) recovered from the flue gases by means of towers. About 80 per cent. water soluble is the practice of many European and American works in which the final recovery is 95 per cent. or over.

LOSS OF COPPER IN FLUE GASES.

A tower was packed with loose stone moistened by percolating water and a quantity of the flue gases drawn through, this quantity being proportioned to the cubic contents of the tower as it would be in actual operation. Analysis of the gases after passing through this tower showed the negligible loss of .008 per cent. Cu. of the weight of ore equal to .21 per cent. of the copper contents. This indicated that a tower of the proportions proposed was capable of much greater duty, but the facilities did not permit of testing it to its limits.

CAPACITY OF FURNACE.

While running at the maximum solubility of 93 per cent. the 26ft. portion of furnace was roasting ore at the rate of 12 tons per day. This appeared to be as much as could be done under the conditions without impairing the solubility; but, using the full length of the furnace and with a second firebox, the output should be doubled, probably, with some economy in the full percentage. A furnace of the Edwards duplex type should again double this capacity, attaining about 40 tons to 50 tons per day.

FUEL CONSUMPTION.

This amounted to about 9 per cent. of the weight of charge, using a somewhat inferior wood.

PYRITES.

The pyrites necessary amounted to 3 per cent. on an ore mixture assaying 3.7 per cent. Cu. Allowing for the sulphur already in the ore this would mean that 2 per cent. pyrites would be sufficient for ore containing 2.8 per cent. Cu.

The data provided by the trial make possible a closer estimate than before, and in a 200 ton per day plant operating on an average grade of 2.8 per cent. Cu, as per Mr. Wainwright's report, the following should be a close approximation to the expenses after delivery of the ore to mill:—

	s. d.
Crushing—One-third of the ore to one-eighth mesh	0 6
Roasting—(Mechanical feed and discharge)—	
Fuel, 10 per cent. wood at 6s.	0 7
Labor, three men each shift charging	—
“ one man each shift firing	—
“ one fitter one shift	0 9
Power, 25-H.P. at 2s.	0 3
Vats, Leaching—Labor discharging	1 0
“ Precip.—Labor on iron and copper	0 3
Smelting precip.	0 5
Pyrites, 2 per cent. at £2 10s. (no deduction for value)	1 0
Salt	0 2
Iron (80s. per ton)	2 3
	<hr/>
	7 2

Making a total, taking mining cost at 4s. 6d. per ton, of 11s. 8d. to produce blister copper at the mine.

Among the above items of cost, that of labor on leaching vats (1s.), is a maximum which may be considerably reduced.

The use of belt-conveyors should show an improvement on this figure, but a method that is promising and worth investigating is to perform the leaching on a Dour classifier. If this can be done it will also obviate most of the inconvenience of using saturated salt solution.

The pyrites cost is also a maximum which may be considerably reduced or eliminated. This may be effected in any of the following ways:—

- (1) By development of more sulphur in the Pernatty ore (unlikely).
- (2) By purchase of cupriferos sulphide ores.
- (3) By regeneration of ferrous chloride and ferrous sulphate in the liquors from precipitation.

Either of the two latter methods should be feasible.

In the above costs 5d. has been allowed for smelting the copper to blister, but it is probable that the precipitate obtained would be of sufficient purity and freedom from valuable metals to make it profitable to refine direct and ship as ingot copper. In this case about 4d. should be added to the smelting cost.

Iron has been allowed for at the rate of £4 per ton. This will be reduced according to the amount of scrap iron which may be secured, the ruling prices for scrap being about 30s. per ton, equal to £2 5s.—£2 15s. at the mine.

COST OF PLANT.

The following would be the approximate capital required for a plant to treat at the above costs 200 tons per day:—

	£
Oil engines, two at 50-H.P. and one electric generator..	2,000
Furnaces, four Edwards duplex or Leggo furnaces and erection	7,000
Acid condensing towers and flues	1,500
Refining furnace	1,000
Motor lorry	750
Buildings	2,000
Rails, trestles, winches, fans, pumps, piping, motors, belts, lights, wire, ropes, &c.	3,000
Stores, iron pyrites, &c.	3,000
Road construction	500
Water supply	2,000
	<u>£22,250</u>

If it were desired to erect a smaller plant, to treat, say, 100 tons per day, the following would be about the lowest estimates consistent with safety:—

	£
Oil engine, one at 50-H.P.	1,000
Furnaces, second-hand	2,500
Acid condensing towers and flues	1,000
Buildings	1,000
Rails, trestles, winches, fans, pumps, piping, belts, lights, wires, ropes, &c.	2,500
Stores, iron, pyrites, &c.	1,500
Water supply	1,000
	<u>£10,500</u>

This plant would probably entail an increase in working costs of 2s. to 3s. per ton.

In the erection of a plant to treat 50 tons per day a further economy of capital might be effected to the extent of about £2,000, but a plant of this size could only be run at an increase of about 5s. per ton or more on the estimated costs, owing to the necessity of shipping copper precipitate to be refined elsewhere and the difficulty of employing labor efficiently on a small plant.

It would be a desirable preliminary to any of the above schemes to install in the first place an Edwards tilting furnace, which could be obtained for £300 to £400 for the purpose of a month or two of experimental work before completing the plant. This furnace, the same as used in the trial at Ballarat, would treat 20 tons to 25 tons per day, and in addition to providing valuable experience in completing the plant would make a small profit.

PROFITS IN SIGHT.

Taking Mr. Wainwright's final estimate of 143,260 tons of 2·8 per cent. ore, the value of the reserves may be estimated as follows:—

Gross value of ore—

2·8 per cent. less 5 per cent. loss .. 2·66 per cent. recovery.

2·66 per cent. Cu at £60 per ton ... 31s. 11d. per ton ore.

Cost of production—

	s. d.
Working cost to refined copper	12 0
Realisation at £3 per ton copper	1 7
	<hr/> 13 7

s. d.

Gross value

31 11

Cost of production

13 7

Net profit per ton

18 4

£

Profit on 143,260 tons at 18s. 4d.

131,321

Less allow for cost of plant, renewals, &c.

25,000

Net profit in sight

£106,321

REPORTS

BY

The Inspector of Mines (Mr. Henry Jones).

LOCALITY—NORTH.

THE WEST BURRA COPPER MINE (*vide* Reviews Nos. 18 and 19).—Situated 3½ miles S.W. from the Burra Burra Mine.

The main underlie shaft on the property is 6ft. x 4ft. in the clear, and has been sunk to a depth of 95ft., with windlass for hauling the dirt and good strong ladders placed in position from surface to bottom. A fairly-defined formation, with a rich seam 3in. to 9in. thick of malachite ore on the hanging-wall, is exposed in the shaft down to the 53ft. level, but at that depth a soft seam of ferruginous material bearing N.E. and going down nearly vertically, came in across the shaft, cutting off the main ore body. The full extent of the displacement in the lode at this point has not yet been determined.

From the 53ft. level to present depth the shaft has been continued down at the same angle as the top portion. The country disclosed in this portion of the shaft appears to have been greatly disturbed and is much broken and twisted, with the occurrence of a small portion of the lode material in places, containing small specks of carbonates and copper pyrites. The various belts of rocks and soft seams exposed in the shaft seem to contain small percentages of copper. Six samples taken from the different belts showing gave an average of 0.53 per cent. copper.

Judging from what can be seen in the present working I would strongly advise to discontinue sinking for a time and to carry on more exploration work in the formation just above where the first break occurs at the 53ft. level; the ore body at this depth appears very promising, and by extending a drive from the shaft on the course of the lode N.E. under the hill a large block of ground for stoping would be made available, and the work done would determine how far the disturbed ground extends along the line of strike, and also be of great assistance in selecting the best site to work and develop the mine to a greater depth. (26-1-14.)

UTICA COPPER MINE (*vide* Reviews Nos. 16, 18, and 19).—Situated in the hundred of Koorunga, 6 miles S.E. from the Burra Burra Mine.

A large amount of sinking and driving has recently been done on this property. No. 2 shaft, which is 5ft. x 4ft. in the clear, is now down to a total depth of 103ft. on the underlie, and in the last 3ft. of sinking a little water was intersected, making about 25galls. per hour. Further sinking has now been discontinued, and the work of extending the drives on the course of the lode at the 100ft. level is in progress.

The S.E. drive is now in a total distance of 37ft. from the crosscut. The lode formation exposed is well defined and from 3ft. to 4ft. wide, and consists mostly of ferruginous quartz containing seams and bunches of high-grade ore, chiefly copper pyrites, copper glance, and malachite. A sample taken for a width of 3ft. in the face of the drive gave 5.2 per cent. copper, one from back of the drive 5.5 per cent., and from a vein 3in. wide near the hanging-wall 10.4 per cent.

The N.W. drive in the lode is in a total distance of 14ft. from the crosscut. The lode is mainly quartz and ironstone, 4ft. wide, showing patches and veins of good ore. A sample taken from the face gave 9.0 per cent. copper, and one sample taken from the back of the drive, for a width of 3ft., gave 4.2 per cent. copper.

The lode formation, so far as disclosed in the present workings, appears very encouraging and is well worth proving to a greater depth by winze sinking. A place for a windlass could be cheaply cut out in the N.W. drive close to the end of the crosscut, where a winze could be sunk 6ft. long by the width of the lode down 100ft. or more, providing the water would not be too heavy to get out with the windlass. The expense of such a direct prospecting work would be money well spent, as the work done would give a very good idea of the width and value of the ore body at a very fair depth prior to equipping the mine with costly machinery. (27-1-14.)

LOCALITY—YORKE PENINSULA.

THE HAMLEY COPPER MINE (*vide* Record, page 61, and Reviews Nos. 9, 10, 13, 14, 16, 18, and 19).

During the last 12 months work at this mine has been carried on by a party of tributers, and operations underground were confined chiefly to the development of the "Karkarilla" lode, N. from No. 1 shaft, at the 50 and 40 fathom levels. A fair amount of driving and stoping has been done at both the above levels, and a wide lode formation has been disclosed, containing several small seams of fairly high-grade yellow ore. From these workings a large quantity of lode material, averaging in the crude state 3 per cent. copper, was extracted, conveyed to the plant on the mine, crushed and concentrated up to 18 or 19 per cent. copper before it was sent to the Wallaroo Smelting Works.

No. 1 Shaft, Fifty-fathom Level.—The N. drive at this level is in a total distance of 114ft., and from a point 63ft. in the drive (and N. of the rise) has been strongly timbered and the ore body over the rock has been stoped out for 45ft. in length by 10 fathoms high up to the next level. The width of the ore body exposed is from 12ft. to 15ft. wide, containing small veins of sulphide ore, both near the foot and hanging walls, with barren rock in the centre of the formation. The stope worked has been filled in with mullock and the S. end been timbered up, leaving a space of a few feet near the breast of ground, so that stoping can be continued in that direction without disturbing the portion already worked out and filled in with mullock.

No. 1 Shaft, Forty-fathom Level.—The N. drive is in a total distance of 130ft. from the shaft, the last 60ft. of the drive has been well timbered and the ore body at the back of the drive stoped up for about 8 fathoms to 10 fathoms in length. The formation exposed is from 8ft. to 12ft. wide, containing seams of sulphide ore. Work was in progress here up to a week or two ago, and the last parcel of ore sent away to the smelters was mainly obtained from this part of the workings.

Judging by what can be seen in the tributers' workings at the 50 and 40 fathom levels, and also that done previously by the company at the 70 and 60 fathom levels N. of No. 1 shaft, there is every indication that the large hanging-wall formation discovered in this part of the mine (and which has been operated on for a length of about 60ft. by a width of from 10ft. to 15ft. from the 70 to the 30 fathom level) is likely to prove a permanent ore body, with every appearance of extending along the line of strike both N. and S., as well as to continue to go down.

Considering the width and probable length of the ore channel exposed in the present workings the future prospects of the property appear encouraging, and when the mine is more extensively opened out and worked on a larger scale a great quantity of low-grade ore, $2\frac{1}{2}$ to 3 per cent. (with probably richer pockets in places), can be extracted from the workings, which, if treated by a plant of modern construction, should show a fair margin of profit. (27-4-14.)

LOCALITY—MOUNT GRAINGER.

THE GOLDEN JUNCTION GOLD MINE (*vide* Record, page 219, and Review No. 19).—Situating N. of the Mount Grainger Mine, gold sections Nos. 299 and 712.

At the 60ft. level in the old underlie shaft stoping is in progress. The formation disclosed in the workings is mainly ferruginous clay-slate with numerous iron and quartz veins traversing it in various directions. The veins vary in thickness from $\frac{1}{4}$ in. up to 2in. wide, carrying gold, and some are fairly rich in places extending for a considerable distance in conformity with the slate beds, with other veins crossing them. At the points of intersection fairly rich ore is generally found.

This large body of gold-bearing material appears likely to extend through the blocks, and if worked on a more extensive scale and the unproductive material picked out, a very large quantity of good grade milling ore could be regularly extracted; 9 tons 4cwts. of ore recently treated at Petersburg Government Cyanide Plant gave an average return of 3ozs. 9dwts. 23grs. of gold per ton.

A sample taken of one of the ore veins for a width of 18in. gave 1oz. 7dwts. of gold and 8dwts. of silver per ton. Two samples taken of the slate material—one gave 1dwt. gold and the other 5dwts. gold per ton. (14-4-14.)

THE DARLEY DAY DAWN GOLD MINE.—Situating $\frac{3}{4}$ mile W. from Mount Grainger.

Several shallow holes have been sunk in different formations exposing ferruginous quartz leaders traversing the slate country rocks in a N.E. and S.W. direction, varying in width from 3in. to 12in., carrying gold and silver.

At one point on the block an underlie shaft is down to a total depth of 20ft. A fairly defined vein of quartz is exposed in the face, bearing N.E. and S.W. with a slight dip to the S.E. The vein is 3in. wide of nice quartz, and may prove to be an offshoot from a larger ore body. A sample taken of the vein material gave 1oz. 7dwts. of gold and 7dwts. of silver per ton.

About 50ft. S.W. from the underlie an open-cut has been made along the outcrop for a length of 10ft. and to a depth of 2ft. to 5ft. A well-defined vein of quartz 3in. to 4in. wide is exposed carrying gold. A sample taken of the vein in the bottom of the cut gave 15dwts. of gold and 12dwts. silver per ton.

The surface indications on this auriferous belt of slate country are of a highly promising nature, and fully justify more systematic prospecting work done on these blocks and others in the vicinity. (15-4-14.)

LOCALITY—NORTH-EAST.

THE GREAT EASTERN GOLD MINE.—Situated on Wadnaminga Goldfield.

This mining property was recently taken up by an Adelaide syndicate, and adjoins the New Milo Gold Mine.

A well-defined lode formation is exposed in the old workings traversing the blocks in an E. and W. direction and dipping S. At different points along the line of strike several underlie shafts were sunk (some years ago) and a fair amount of stoping work done below, from which a large quantity of lode material appears to have been extracted. The property appears a very promising one, having such a long length of gold-bearing lode disclosed, which fully warrants being further developed by deeper sinking and driving along its course. Preliminary surface work has been commenced by the present company. A cyanide plant has arrived on the mine for treating the large dump of tailings stacked on the property, and the manager anticipates to have the erection completed and the plant going in a short time. (2-4-14.)

THE NEW MILO GOLD MINE (*vide* Record, page 322, and Reviews Nos. 10, 11, 14, 18, and 19).—Situated at Wadnaminga.

Underground development work at this mine is proceeding satisfactorily; stoping and driving are carried on in the W. drive off the main underlie shaft at the 370ft. level. The ore body in the stope and along the drive is well defined, consisting of ferruginous quartz and ironstone 17in. to 24in. wide, carrying gold. Some of the stone is fairly rich, showing nice specks of gold; 30 tons 10cwts. recently treated from the W. workings at Petersburg Cyanide Works gave a total return by battery of 15ozs. 16dwts. of smelted gold and 14dwts. 12grs. left in the tailings. Another parcel of ore will be shortly sent for treatment; there are about 8½ tons already bagged at the mine. (2-4-14.)

GOLDEN RECORD GOLD MINE (*vide* Record, page 321, and Reviews Nos. 14, 15, 18, and 19).—Wadnaminga.

The principal work in progress at present is the sinking of a small underlie shaft in the lode, following the course of a small cross-leader (or indicator). Fairly rich gold-bearing stone is generally found on this property at points where the cross-leaders intersect the main lode. The shaft is now down 80ft. The lode in the bottom is 12in. wide, carrying a little gold. (2-4-14.)

THE VIRGINIA GOLD MINE (*vide* Record, page 323, and Reviews Nos. 14-18).—Wadnaminga Goldfield.

No work has been carried on underground for several weeks. A very strong thunderstorm passed over the field, with a heavy downfall of rain, and a large quantity of water from the old dam went down one of the underlie shafts, filling all the workings to within a few feet of the surface. With a view to preventing the overflow of water from the dam getting into the mine in future, and to make the mine quite secure and safe, the work of excavating a large channel between the dam and the workings to carry the overflow water to the Main Creek has been started, and is now in progress. When that work has been completed and the water pumped out of the workings, work underground will be resumed.

The cyanide plant on the mine is doing good work with treating the tailings and sand dump. Two new vats have been added recently to the plant. The quantity of tailings already treated amounts to 1,825 tons, yielding in money value £875. (9-4-14.)

THE RADIIUM HILL MINE (*vide* Record, page 361, and Reviews Nos. 10-19).

The sinking of No. 2 shaft is now in progress and is down a total depth of 140ft. The formation disclosed is well defined, with two good walls from 3ft. to 3ft. 6in. apart, and consists chiefly of soft black mica (biotite) containing small nodules of iron. A little water is at present making in the bottom of the shaft, and probably by sinking deeper a good supply will be obtained for the plant.

SOUTH AUSTRALIAN RADIIUM PROPRIETARY MINE (*vide* Reviews Nos. 17, 18 and 19.) At the time of my visit there was no one working on this property, and the underground workings could not be inspected.

THE RARE METALS PROPRIETARY RADIIUM MINE (*vide* Reviews Nos. 17, 18, and 19). A main working shaft has been recently sunk on this property, 6ft. x 4ft. in the clear and down apparently to a depth of 70ft. No work was in progress at the time of my visit. (4-4-14.)

PERSEVERANCE SILVER-LEAD MINE (*vide* Record, page 194, and Reviews, Nos. 9, 10, 14, and 18).—Situated 2 miles from the Lux Mine, near Olary.

The property comprises two amalgamated blocks, Nos. 8803 and 9429) of 40 acres each. A large amount of work has been done at different points disclosing the outcrop of a lode formation bearing N.W. and S.E., dipping S.W. at an angle off the horizontal of 26°. Several underlie shafts from the outcrop have been sunk in the lode to depths of from 20ft. to 60ft., drives extended at different levels, and the ore body stoped out for a great length along the line of strike, and in some places up to the surface. The greater portion of the old workings are now inaccessible, having fallen in and filled up with mullock. The ore-bearing material disclosed consists mainly of schist, quartz veins, and ferruginous decomposed rock, 18in. to 30in. wide. The silver-lead ore (galena) occurs in shoots, pockets, and small nodules in the lower portion of the formation near the footwall for a width of 12in., and from the various workings it is said that a total of over £2,000 worth of fairly high percentage ore has been extracted.

The new workings consist of a vertical shaft situated S.W. from the outcrop on the dip side of the lode, which is down a total depth of 40ft. The formation was intersected at 38ft. from surface, and from the bottom of this shaft a drive in the lode has been extended N.W. for a distance of 33ft. At that point a small ferruginous break in the country crossed the drive, dipping N.W. at an angle of 38°. The drive was continued down on the angle of break for a distance of 23ft.; at that depth a cross-course or fault in the country was intersected and the drive was further extended a distance of 10ft. in broken country consisting of boulder conglomerate and schist. Two samples taken from different parts of the cross-course shows that it contains no values. A sample taken at the top of the underlie from the ferruginous break gave 3.6 per cent. lead and 8dwts. of silver per ton.

Off the main drive 12ft. N.W. from the shaft a winze has been sunk in the formation to a depth of 21ft. The lode exposed has a well-defined footwall, and is from 12in. to 15in. wide, with specks of galena in places.

Surface.—Recently a bore hole has been put down at a point on the surface 150ft. from the outcrop to the dip of the lode, and is now down a depth of 145ft. 6in. The boring plant in use to do the work was a jumper drill. There was no core obtained to enable one to determine the true nature of the strata passed through. Judging by the position of the bore compared with that of the cross-course in the workings it appears to me that a large portion of the boring was done in the disturbed zone or faulty country, which accounts for the lode not being intersected.

Judging from what can be seen in the shallow workings, and the quantity of ore obtained to present depth, the prospects of the property are of a very encouraging nature, and fully justify the work of testing and exploring the formation to a much greater depth, and that could be done at comparatively small expense by starting an underlie shaft from the bottom of the 40ft. vertical and carrying it down to a depth of 100ft. or more, then drive both ways on the course of the lode; the work

would prove the shoots of ore at reasonable depth and open out the mine. A sample taken of the galena ore on surface obtained from the workings gave 78.6 per cent. lead, 18ozs. 12dwts. silver per ton. (3-4-14.)

THE NEW YEAR GIFT COPPER AND COBALT MINE (*vide* Record, page 53, and Review No. 19).—The property is situated near Ethjudna Hill, about 21 miles W. from Bimbowrie H.S. and about 36 miles N.W. from Mannahill.

The present main workings are on block No. 7116, and consist of a vertical shaft and several open cuts and shallow prospecting holes situated on the brow of a granitic hill about 60ft. above the plain.

Traversing the hill at different points the outcrops of four copper-bearing formations are exposed in the various workings, varying in width from 6in. to 24in. of decomposed gneiss, containing chiefly hydrous silicate of copper (chrysocolla) with small percentages of nickel and cobalt.

Three of the above-mentioned formations have a N.E. and S.W. bearing dipping N.W., the other one is crossing them in an E. and W. direction. A fair amount of work has been done along the outcrop of the E. and W. deposit for a length of about 70ft., and to a depth apparently of 6ft. to 8ft.; but, as the sides of the cutting had fallen in and the workings are full of mullock, the formation could not be examined to determine its width and value. Seeing that so much work has been done at different times along the outcrop of this formation it appears to me that it is well worth expending a few pounds on the work of cleaning out part of the workings to expose the ore channel in the bottom, so that it could be fully examined.

The eastern one of the parallel formations is disclosed in two shallow pits sunk in the outcrop to a depth of 4ft. to 5ft. The vein of ore exposed in the bottom is well defined, varying in width from 3in. to 12in., containing hydrous silicate of copper, with copper stains in the cleavage and joints of the adjacent rocks. A sample taken of the vein material from the bottom of the deepest hole for 9in. wide gave 4.7 per cent. copper and traces of nickel and cobalt. To further prove and to ascertain the width and value of this formation at greater depth the best and cheapest plan would be to carry down an underlie shaft in the ore channel.

Middle Lode Formation.—Open-cut workings have been made in this lode for a length of 30ft. by about 8ft. in depth. Large portions of the cutting have been filled in with mullock from the adjacent shaft, but the N.E. end has been left open for a length of about 10ft. by 6ft. to 8ft. in depth. The formation disclosed has a fairly defined footwall, and consists mainly of decomposed ferruginous gneiss impregnated with hydrous silicate of copper, with a small vein, 3in. to 6in., near the footwall, of high-grade ore. There is no hanging-wall showing, but the country on that side of the vein shows copper stains for some distance. A sample taken for a width of 18in. in the bottom of the hole assayed 9.6 per cent. copper, 0.2 per cent. nickel, and 0.4 per cent. cobalt.

The N.W. run of ore is situated about 16ft. from the last one, running parallel, and has been disclosed by a hole sunk in the outcrop to a depth of about 4ft. The vein showing in the bottom of the hole is from 3in. to 6in. wide, containing copper ore, which may make wider at greater depth.

Considering the adjacent relative positions of the last-mentioned two ore bodies (the middle and N.W. formations), both could advantageously, and at comparatively small outlay, be systematically prospected and exploration work carried down in them to a great depth by the sinking of an underlie shaft in the middle formation, and the putting in of crosscuts in the hanging-wall to intersect the other body, thus proving the two formations as work is proceeding downwards, and (if found of payable nature) both formations could be operated on by drives and stoping, and the material hauled up to surface through the one shaft.

Work in Progress.—A short distance N.W. from the outcrop of the middle lode (on the dip side) a vertical shaft has recently been sunk to a depth of 23ft. At a depth of 6ft. from the surface the lode formation crossed the shaft, dipping N.W. and showing a width of 2ft. to 3ft. of decomposed gneiss with a rich vein, 5in. to 9in. wide, of hydrous silicate of copper on the footwall. At the bottom of the shaft cross-cutting is in progress to intersect the same ore channel at that level. The crosscut is now in 11ft., and should cut the ore, if it continues down at the same angle, within the next 6ft. or 8ft. of driving. Should the ore body, when intersected in the crosscut, be of a nature to warrant developing at a greater depth, as it shows in the open cut and where passed through in the shaft (at both these places it appears fairly promising), then, as already stated in this report, the proper method at the present stage of the mine to further prove and develop the ore bodies now showing is by carrying down an underlie shaft in the ore channel from the surface.

Near the N.E. boundary of the block an underlie shaft is down 40ft. and has recently been cleaned out and put in order; a fairly defined formation is disclosed all the way down bearing N. and S., dipping W., and consisting of decomposed gneiss and siliceous ironstone with copper stains for a width of 2ft. A sample taken from the face gave 1.3 per cent. copper and traces of nickel and cobalt. In the formation at the bottom of the shaft in one corner an isolated bunch of rich ore, 8in. thick, was showing. A sample taken of that bunch gave 28.4 per cent. copper and traces of nickel and cobalt. Further sinking should be done to ascertain if this good ore will continue to go down. About half-way down the shaft a small vein of ore (5in.) is showing in the footwall. A sample taken of the material gave 1.0 per cent. copper, 0.1 per cent. nickel, and 3.5 per cent. cobalt. About 60ft. W. from the underlie workings a vertical shaft is down 30ft., and is now used for holding rainwater for the use of the camp.

The S. central workings on the block consist of an open cut, 8ft. to 10ft. deep, made along the outcrop of copper-bearing material in an E. and W. direction for a length of fully 60ft., but as these workings are now partly filled up with mullock very little of the formation operated in could be seen except for a short distance in the W. end. At that point a well-defined footwall was showing, with copper-stained material 5ft. to 6ft. wide. A sample taken for the full width, at 10ft. deep, gave 7.2 per cent. copper and traces of nickel and cobalt. This formation could be further proved and developed by sinking an underlie shaft at the W. end of the old working and carrying it down on the footwall, and when down a reasonable depth put in a test crosscut into the hanging-wall.

Block No. 7114.—Some surface prospecting work appears to have been done at one time on this block. Several shallow holes, 2ft. to 3ft. deep, have been made at different points along the slope of a granitic hill, where copper-stained gneiss and quartz are showing along the surface, but there does not appear to be any defined run of ore discovered so far. A sample taken from a 4in. vein in the bottom of a 3ft. hole gave 2.1 per cent. copper, 0.1 per cent. nickel, and 0.1 per cent. cobalt. A sample taken from a 6in. vein in a 2ft. hole gave 2.6 per cent. copper, 0.1 per cent. nickel, and 0.1 per cent. cobalt.

Block No. 7115.—Called Look-out Hill. A fair amount of prospecting work was done on this block 25 years ago. One shaft, 6ft. by 3ft. in the clear, has been sunk vertical to a depth of 40ft. At a point 15ft. E. from the shaft a trench has been made 40ft. long by 3ft. to 4ft. deep, and in the N. end of the cutting a lode formation is exposed bearing E. and W. dip S. toward the shaft, and should be cut in the latter at little deeper sinking. The formation consists of decomposed gneiss with hydrous silicate of iron (glauconite) 4ft. wide, containing a small percentage of copper. A sample taken for full width of lode gave 1.6 per cent. copper, traces of nickel and cobalt. In the S. end of the cutting a quartz lode, 2ft. wide, is exposed bearing E. and W. dipping S. A sample taken for full width gave 4.6 per cent. copper, with traces of nickel and cobalt; at several other parts of this block copper-stained material can be seen on the surface.

Block No. 8243.—The principal work that has been done on this block is a shaft (known as Piper's) sunk 20ft. vertical, and said to be 30ft. on the underlie. The lower portion of the shaft from about 12ft. down is now full of mullock. From the underlie, at 12ft. below the bottom, vertical drives in the lode have been extended E. and W. The W. drive is in a total distance of 40ft., but for the greater portion the drive and stopes are in a dilapidated condition and will require a lot of work to put in order. The formation exposed in the working is soft decomposed ferruginous material 2ft. wide, with copper stains extending into the joints and cleavages of the hanging-wall country. A sample taken from the face of the drive gave 4.9 per cent. copper, 0.1 per cent. nickel, and 0.5 per cent. cobalt. A sample taken in the back of the stope, half-way in the drive, gave 6.3 per cent. copper and traces of nickel and cobalt. The E. drive at the same level is in a total distance of 20ft. The ore-bearing material here is of a more solid nature, showing copper stains through the rocks for a width of 4ft. to 5ft., with rich vein of ore, 6in. or 9in. wide, near the footwall. A sample taken of the vein gave 12.2 per cent. copper, 0.2 per cent. nickel, and 0.5 per cent. cobalt, and sample taken across the back of the drive near the shaft gave 7.1 per cent. copper, 0.2 per cent. nickel, and 1.0 per cent. cobalt. The ore body in this part of the workings, and especially the seam of ore in the face, appears very promising and likely to extend E. under the hill. To further prove and develop it at present level it will be necessary to clean out the drive and put in timber where required, so that driving in the ore channel could be extended E.

So far the amount of work done on the property is shallow and of a prospecting nature, but in the various workings seams of high-quality ore have been disclosed, and, although not very wide near the outcrops, the possibility is that the shoots of ore will lengthen and make wider down in the more settled country. To further prove the various seams at greater depth shaft-sinking in the ore channels would be the best mode at present. A sample of the ore passed through in the vertical shaft gave 19.2 per cent. copper, 0.1 per cent. nickel, and 0.5 per cent. cobalt. (7-4-14.)

THE HOMEWARD BOUND GOLD MINE (*vide* Record, page 246, and Reviews Nos. 9, 11, 14, 15, 18, and 19).—Situating near Mannahill.

The vertical shaft on the property has been continued down to a depth of 30ft. from the surface. At that depth the main lode formation was intersected, and driving in the ore body, both E. and W., is now in progress. The E. drive is in a total distance of 30ft.; the lode material exposed consists of ferruginous calcite with hydrous carbonate of bismuth, 9in. to 15in. wide, containing fairly rich patches of gold in places.

The W. drive is in a total distance of 12ft. and a stope carried in S. for 20ft. The lode is well defined and from 6in. to 12in. wide, carrying gold. The last parcel of 5 tons of ore from these workings recently treated at Petersburg Cyanide Works gave a return of 1oz. 15dwts. of gold per ton. There is another parcel of about 5 tons of ore on surface which the owner anticipates will give fairly high returns. A hand sample taken from the dump of ore on surface, which must have contained bits of fairly rich stone, gave 10ozs. 18dwts. of gold and 1oz. 14dwts. of silver per ton and 0.4 per cent. bismuth. The persistent nature of the long length of ore already proved on this property fully justifies deeper sinking in the lode to open out and work the mine in a more extensive manner. (9-4-14.)

LANGFORD'S MINERAL CLAIM (*vide* Review No. 19).—Situating at Lovely Gully, near Waukaringa.

The principal work at present in progress is the sinking of a prospecting pit in the footwall country of the Laura underlie shaft. The pit is vertical, and is now down a total depth of 20ft. The country rock exposed is hard calcareous sandstone. At the bottom of the pit a start has been made to drive S. with a view to intersecting the copper lode that shows on surface to underlie the Laura formation.

E. from the underlie shaft three prospecting pits have recently been sunk along the outcrop to depths of 8ft., 11ft., and 12ft. respectively. Lode material with copper stains was intersected in each. In the E. pit, at a depth of 12ft., a vein 3in. to 5in. wide containing carbonate of copper was struck. Sinking on the underlie of the vein was continued down a further depth of 8ft. The material exposed is of low grade. A sample taken gave 0.5 per cent. copper and 1dwt. of gold per ton.

Several shallow prospecting holes have been sunk in the alluvial deposit traversing the block, and 2ozs. of fine and coarse gold were obtained recently from the different workings. (11-4-14.)

LOCALITY—EYRE PENINSULA.

THE COWELL SILVER-LEAD MINE (*vide* Reviews Nos. 17, 18, and 19).—Situated in the hundred of Miltalie, about 18 miles from Franklin Harbor.

A large amount of good prospecting work has been done to shallow depths in the vicinity of Atkinson's find, and now it has been decided to prove the ground at deeper levels.

At a point on the hill 20ft. S. from the old workings a new vertical shaft, 6ft. 6in. by 3ft. in the clear, was recently started, and has now been sunk to a depth of 80ft. For some distance down the shaft the country appears to have been much disturbed by faults; but the lower portion of the shaft is now in more settled country, and I would most strongly recommend to continue sinking the present shaft to a depth of at least 100ft., as that would give a reasonable depth below the apparently disturbed zone for carrying on further exploration work by cross-cuts and drives.

The N. drive at the 25ft. level in the main shaft is in a total distance of 18ft. At that point the drive holed through to Atkinson's E. workings; the material exposed in the drive is chiefly ferruginous claystone with a well-defined footwall showing for a length of 10ft. and consisting of jointed limestone with little quartz. The joints or small channels are all closely filled with sediment, evidently deposited at one time by water; from samples taken and assayed, the sediment does not appear to carry any value, but the enclosing rock contains patches of lead carbonates and silver. Three samples were taken at this level from different parts of the drive.

No. 1 sample, taken from the soft material on the wall 1in. to 3in. thick, was nil.

No. 2 sample, taken from a seam of sediment in the footwall 5ft. in from the shaft, nil.

No. 3 sample, taken of the hard material forming the footwall 6ft. in from the shaft, gave 0.3 per cent. lead and 37cozs. of silver per ton.

At the 50ft. level a drive has been extended S. 14ft.; from that point the drive was continued in a S.W. direction a further distance of 16ft., or a total distance of 30ft. from the shaft. The first 14ft. of driving was done in hard jointed limestone and decomposed material similar to that showing in the footwall at the 25ft. level, and the S.W. portion of the drive was done in soft ferruginous claystone.

Three samples were taken at different parts of this drive—

No. 1, from a point 12ft. from the shaft, gave 27.1 per cent. lead and 22ozs. silver per ton.

No. 2, taken along the side of the drive for 16ft. back from the face, nil.

No. 3, taken from a seam of sediment 4ft. in from the shaft, nil.

All indications in the present workings show that the country becomes of more settled nature as depth is attained.

The shaft is in good order, and has been equipped with proper ladders and horse whip. Everything appears in good way for testing the property at greater depth. (31-5-14.)

THE ELSON SILVER-LEAD MINE (*vide* Review No. 19).—Situated in the hundred of Mann, 1 mile E. from Cleve.

The workings are on section 48 and consist of two shafts and several open trenches and shallow prospecting holes.

The main vertical shaft has recently been continued down to a depth of 55ft., and at the bottom a crosscut has been extended W. a distance of 27ft. At a point 4ft. in from the shaft a lode formation with fairly defined walls 3ft. apart was intersected. The lode matrix is chiefly schist and a little quartz, which does not appear to contain any mineral value at this level. A sample taken across the full width showed nil on assay. From the formation up to the face of the drive the material exposed is mainly schist. A sample taken for the full length of the drive gave no values.

At the 34ft. level in the shaft a drive has been extended in a N.W. direction for a total distance of 30ft., and at a point 15ft. from the shaft a winze has recently been sunk to a depth of 8ft. The material exposed in the drive and winze is chiefly schist containing isolated specks and small veins of galena, which do not continue far in any direction. The country rock at this level appears to have been greatly disturbed by a number of faults which conspicuously show in different parts of the workings, and so far nothing of permanent nature containing values has been discovered here.

From the plat near the shaft a drive has been extended W. a total distance of 13ft. At that point a lode formation 3ft. 6in. wide was intersected consisting of ferruginous slate and quartz; when first intersected small specks of galena were obtained in the matrix. A sample taken across the lode in the present face gave no values. A sample taken from a small vein E. side of winze at 38ft. level, 4.3 per cent. lead and trace of silver. A sample taken from the S. side of the winze at 36ft. level, for a width of 12in., gave 34.8 per cent. lead and 4ozs. 4dwts. silver per ton. The formation showing, going S., near the top of the winze appears promising, and could be further tested by extending a drive in it in a S. direction.

About 20ft. S.W. from the main shaft a shaft has recently been sunk in the formation to a depth of 18ft.; the lode showing consists of ferruginous slate and quartz containing small seams and bunches of galena, which in places extend into the joints of the adjoining rocks, forming a width of from 12in. to 36in. A sample taken for a width of 3ft. in the bottom of the shaft gave 9.3 per cent. lead and 3ozs. 4dwts. silver per ton. The ore-bearing material showing in the shaft, although not of high grade at present depth, could be further tested at comparatively small expense by continuing down the shaft at a greater angle to the N. to connect the two workings for ventilation, and to more fully prove the ore in that direction.

So far, the development at the present depth in this mine is not very encouraging. A sample taken from a small bag of ore on surface, obtained in sinking the winze, gave 21.8 per cent. lead and 2ozs. 12dwts. silver per ton. (1-6-14.)

THE MILTALIE SILVER-LEAD AND COPPER MINE (*vide* Reviews Nos. 12, 15. and 18).—Situated 17 miles N.W. from Franklin Harbor.

No work is carried on at present in the main workings of the Miltalie property, and the lower workings are full of water. There are several tons of second-class ore obtained from the upper levels stacked on the surface. Two samples were taken from different parts of the ore dump—No. 1 gave on assay 20.8 per cent. lead, 2.9 per cent. copper, and 16dwts. of silver per ton, and No. 2, 28.9 per cent. lead, 1.8 per cent. copper, and 18dwts. silver per ton.

About half a mile in a N.E. direction from the Miltalie mine some prospecting work is in progress on the banks of the *Wilklow Creek*; a fair amount of work appears to have been done here some 24 years ago. On the E. side of the creek two old shafts, 1 chain apart, are visible, and it is said they were sunk to depths of 20ft. and 40ft., both shafts are now filled up with debris carried in by the overflowing of the water in the creek.

The above-mentioned old workings are situated on sections Nos. 49 and 50, hundred of Miltalie, and Mr. E. J. Haddrick has pegged out mineral claim No. 9595 of 40 acres, and has made a start to clean out the 20ft. shaft with a view to further testing the property. The shaft has been equipped with rope and windlass and cleaned out to a depth of 12ft., and it is expected to have all the debris out in a few days' time. (31-5-14.)

LARKIN'S FIND.—Situated on section 28, hundred of Hawker, about 16 miles from Cowell.

A fair amount of prospecting work has recently been done on this block in a formation consisting mainly of hard ferruginous quartzite, with veins of quartz, bearing nearly N. and S. with a slight angle to the W.

The workings consist of a drive started from the side of a small hill, and carried down S. on an irregular incline for a distance of 60ft. At that depth a crosscut has been started W. The material exposed so far in the workings is chiefly quartzite, and, as shown by two samples taken, contains no mineral of any commercial value to present depth. A sample from the face of the drive for a width of 3ft. at 60ft. level gave nil, and one sample taken for a width of 3ft. at 50ft. in shaft gave no values.

The prospects of discovering a payable lode on this part of the block appear discouraging, as there are no indications on the surface or in the present workings of the occurrence of a proper ore channel in the vicinity. (31-5-14.)

GRAPHITE SHOW.—Situated in the hundred of Roberts, 9 miles N.W. from Arno Bay and about 6 miles due E. from Mount Priscella.

The prospecting workings are situated on section 43, and comprise two pits 5 chains apart. No. 1 is down a total depth of 10ft. After sinking 3ft. through surface soil the graphite schist was intersected, and continued in the shaft to present depth; the same material is showing strong in the bottom of the shaft and also in the sides and ends of the workings. A distance of 5 chains further E. No. 2 pit has been sunk through 2ft. 6in. of surface soil and 5ft. 6in. into the graphite bed.

The deposit, judging from what can be seen at different points on the surface and in the present workings, appears fairly extensive and shows higher percentage of carbon at the deepest point tested than close to the surface, as proved by four samples taken—

No. 1, taken across N. end of 10ft. pit in the bottom, gave 12.4 per cent. carbon.

No. 2, S. end at 9ft. deep, 12.2 per cent. carbon.

From bottom of No. 2 pit, at 8ft. in depth—No. 1 sample gave 7.5 per cent. carbon, and No. 2 sample, at 6ft. from surface, gave 5.6 per cent. carbon.

The graphite material so far exposed on the property appears of promising nature and justifies testing at greater depth. (3-6-14.)

